Breakout Group Discussion Summaries from Day 1

Discussion Questions from Day 1

- Has BLM overlooked any important regional and SEZ-specific resource conditions, trends, and impacts?
- How would you prioritize these resources and impacts?
- Provide feedback on the draft management questions and their relationship to long-term monitoring. What would you add or remove?
- Are there existing and relevant data, studies, or models that should be used in developing the Riverside East SEZ strategy?
- What do you or your organization need in order to effectively participate as a stakeholder?

Group 1

- Has BLM overlooked anything?
  - Dark night sky
  - Maintaining wilderness characteristics
  - Increased population and visitation to the area

- How would you prioritize these resources and impacts?
  - Cumulative impacts to DOD uses
  - How will diverting monsoonal rains affect surface water
  - Avian mortality
  - Desert pavement and resulting dust
  - Biological, cultural and visual
  - Identifying functional connectivity areas
  - Microphyll woodland
  - Desert tortoise demography and location
  - Physical impacts

Group 1, cont.

- Provide feedback on the draft management questions and their relationship to long-term monitoring. What would you add or remove?
  - Maintain wilderness characteristics
  - Specify military use impacts
  - Happy with the questions overall

- Are there existing and relevant data, studies, or models that should be used in developing the Riverside East SEZ strategy?
  - DRECP datasets
  - Databasin.org
  - CEC website
  - South Coast Wildlands

- What do you or your organization need in order to effectively participate as a stakeholder?
  - Have a central clearinghouse of data
  - Site specific study should be used in developing the long-term monitoring dataset
  - Monitoring studies should address large scale causality questions – can we attribute changes in animal populations to solar energy development or something else

Group 2

- Overlooked conditions, trends, and impacts:
  - Ozone (near ground level)
  - Migratory birds (what do we know about migration patterns over SEZ?)
  - Aerial invertebrates
  - Plant pollination (rare pollinators of rare plants) and seed dispersal processes
  - Creation of habitat for new predators
  - Night skies
  - Public health (e.g., valley fever, residual mineral development contamination [tailings and air dispersal if soil disturbance from development])

Group 2, cont.

- Individual Priorities (not group prioritized)
  - Wildlife (ground-dwelling species, avian species)
  - Sand transport systems (maintain natural variability)
  - Groundwater (plant biomass; flow to Colorado River)
  - Microphyll woodlands
  - Invasive species
  - Night sky
  - Soundscape
  - Changes to access (attraction to development)

Group 2, cont.

- Existing Data
  - Vegetation data layer and attributes (DRECP)
  - Joshua Tree NP datasets: Night sky, air, invasive species, groundwater, wildlife observation, vegetation, paleontology, surface water, soundscapes
  - Air quality data from Mojave Desert Air Quality Management District
  - 2010 REA Lessons Learned

Note: Consider stratification of data based on temporal and weather conditions

Group 3

- Has BLM overlooked anything?
  – Impacts to night skies, and release of carbon sequestered in soils
  – Trend in greenhouse gas emission/ meeting mandates for renewable energy
  – Cumulative impacts, including development on private lands

- How would you prioritize these resources and impacts?
  – Joshua Tree NP – air quality, groundwater use, visual resources, and dark night skies
  – Surface water flows and impacts to cultural resources

Group 3, cont.

- Provide feedback on the draft management questions and their relationship to long-term monitoring. What would you add or remove?
  - Some monitoring objectives aren't objectives, e.g., monitor the integrity of archeological sites, monitor off-site dust, etc.)
  - Add consideration of erosion patterns to monitoring objectives
  - Add a monitoring objective: "PM within all Class I areas in area of impact not to exceed XX".

Group 3, cont.

- Are there existing and relevant data, studies, or models that should be used in developing the Riverside East SEZ strategy?
  - Important to use data from existing monitoring reports to inform this process
  - Measure effectiveness of current project-specific mitigation measures (review design features)

- What do you or your organization need in order to effectively participate as a stakeholder?

Group 4

- Has BLM overlooked anything?
  - Rock hounding and access to Arlington Mine
  - Bird Mortality

- How would you prioritize these resources and impacts?
  - Groundwater
    - Desert Drywash Woodlands, downstream of solar facilities
  - Special Status Species
    - Population trends first, habitat second
  - Bird Mortality
    - Population trends
  - Invasive species/Weeds
  - Wilderness
  - Sand transport
  - Economics

Group 4, cont.

- Are there existing and relevant data, studies, or models that should be used in developing the Riverside East SEZ strategy?
  - Collaborative monitoring effort
    - Do not monitor the same resources other organizations are monitoring, share data
  - There is existing data, especially where there is a project
  - Use existing weather information, or add BLM weather stations

Group 4, cont.

Other discussion topics:

- Scale of the long-term monitoring?
  - Depends on the resource
- Where to monitor?
  - Prioritizing where to monitor: wilderness areas, inside of the SEZ, regional, close vs. far
- Quantitative objectives
  - Threshold/trigger
- Careful linkage of facility monitoring and regional monitoring
- Effectiveness monitoring

Riverside SEZ Hydrologic Studies

BLM California Desert District (DOI)
Argonne National Laboratory and
Lawrence Berkeley National Laboratory (DOE)

Renewable Energy & Water Issues

- Large-scale renewable energy development in desert regions causes changes to surface water flow patterns, and possibly to water quality.

- These projects require varying amounts of water, which would primarily come from groundwater.

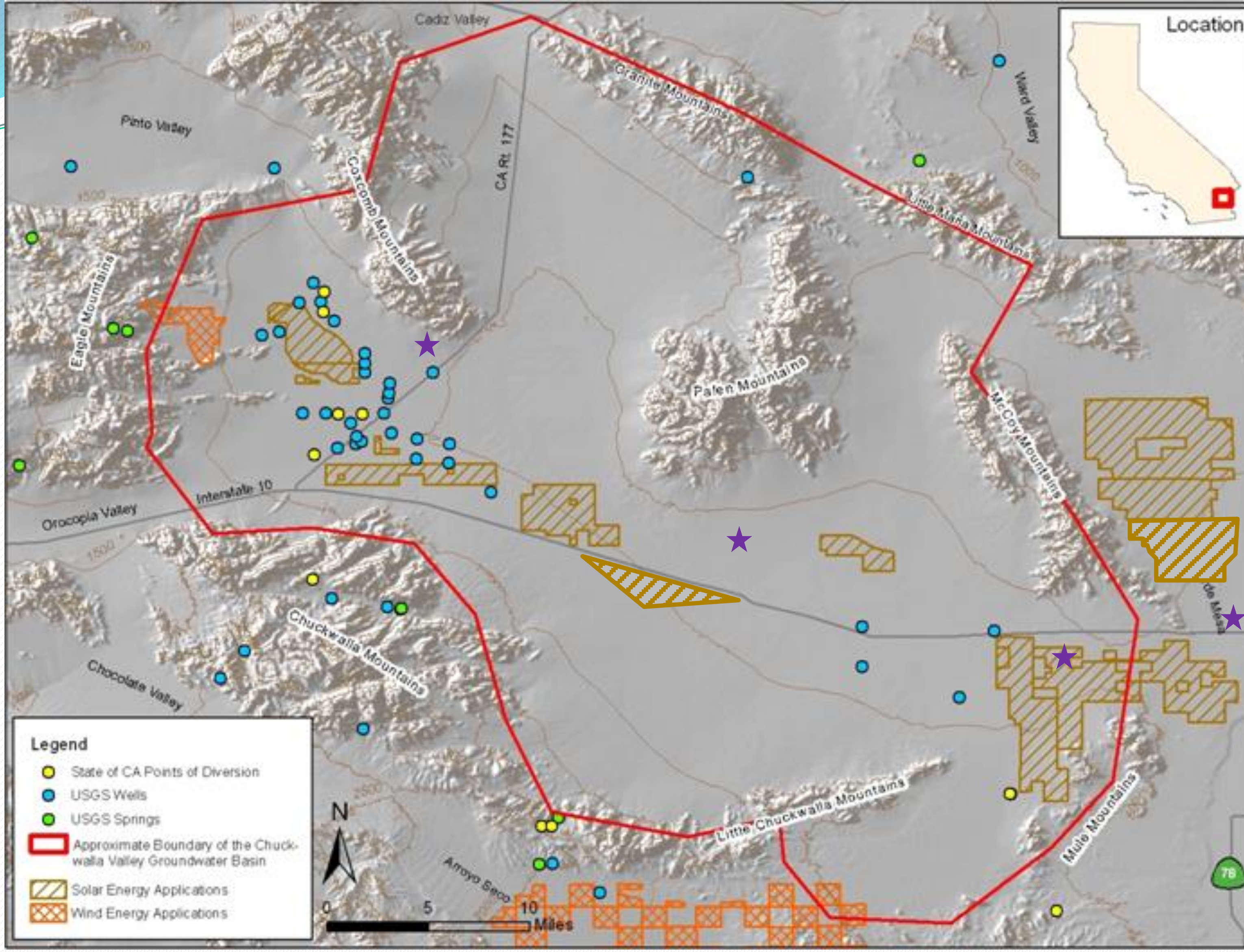
- Requires an analysis of surface flow patterns, the availability of groundwater, and project-related impacts on these.

Renewable Energy & Water Issues

- **Solar projects in the Riverside East SEZ must demonstrate that water resource impacts would be mitigated or avoided. Developers must:**
  - **Model surface water and groundwater impacts prior to completion of the NEPA process**
  - **Monitor these resources onsite and nearby, and adjust project management based on monitoring results**
- **But until now there has been no independent, basin-wide monitoring or modeling.**

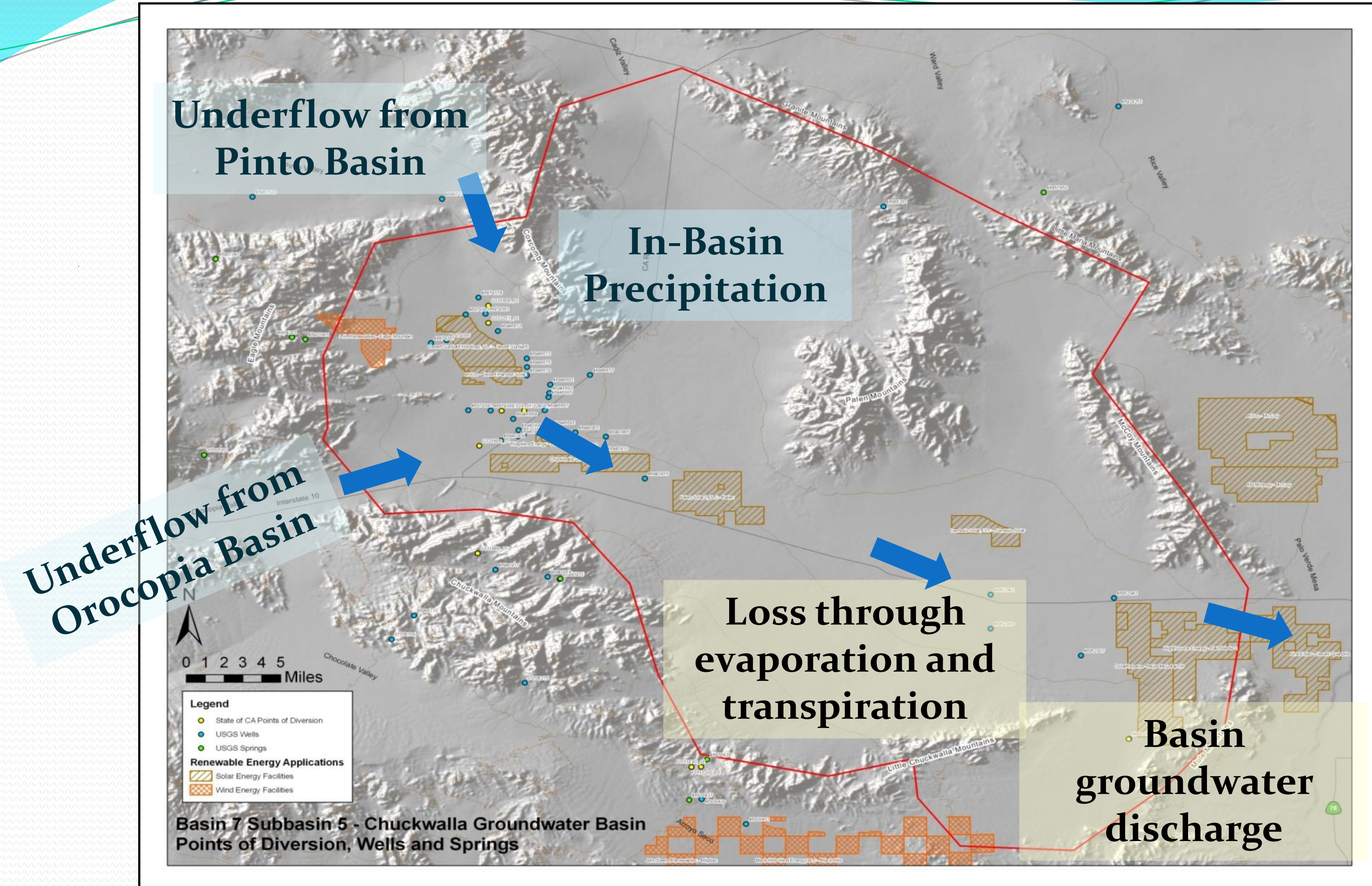
Mean Proposed Water Usage by CA Large-Scale Solar Energy Projects

By Project Type	afy/acre, Construction	afy/acre, Operation	afy/MW
Solar Photovoltaic	0.312	0.009	0.082
Solar Thermal, Wet Cooling	0.465	1.063	10.127
Solar Thermal, Dry Cooling	0.154	0.066	0.476
Wind	0.160	0.001	0.001



Map of the Chuckwalla Valley. Red line = boundary; brown polygons = solar energy projects; circles = wells and springs; stars = climate & soil monitoring stations.

Water Budget for the Chuckwalla Basin



Some estimates of discharge exceed maximum recharge estimates.

Basin	NPS Extrapolation	Eagle Mountain FEIS / Water Board EIR
Chuckwalla Valley Groundwater Basin	2,060 – 4,120	6,125
Pinto Valley Groundwater Basin	624 – 1,248	5,875
Orocopia Groundwater Basin	329 - 658	700
Total Chuckwalla Basin Recharge (from inflow + precipitation)	**3,013 – 6,026**	**12,700**

Chuckwalla Valley groundwater recharge estimates, in acre-feet per year (afy)

Basin Water Balance

- Currently there is a wide range of estimates of the rate of recharge to the basin's groundwater, and for the water balance overall.

- BLM has teamed with Argonne National Lab (ANL) and Lawrence Berkeley National Lab (LBNL) for studies to produce defensible, data-intensive determinations of the basin's water balance for analysis of energy project impacts.

BLM-ANL Water Study

- Conducted in 2012-2013
- Used standard MODFLOW program
- Consisted of an initial, one-layer model and a revised, 3-layer model
- Calibrated to data from two periods: pre-1942, and 1942-2010

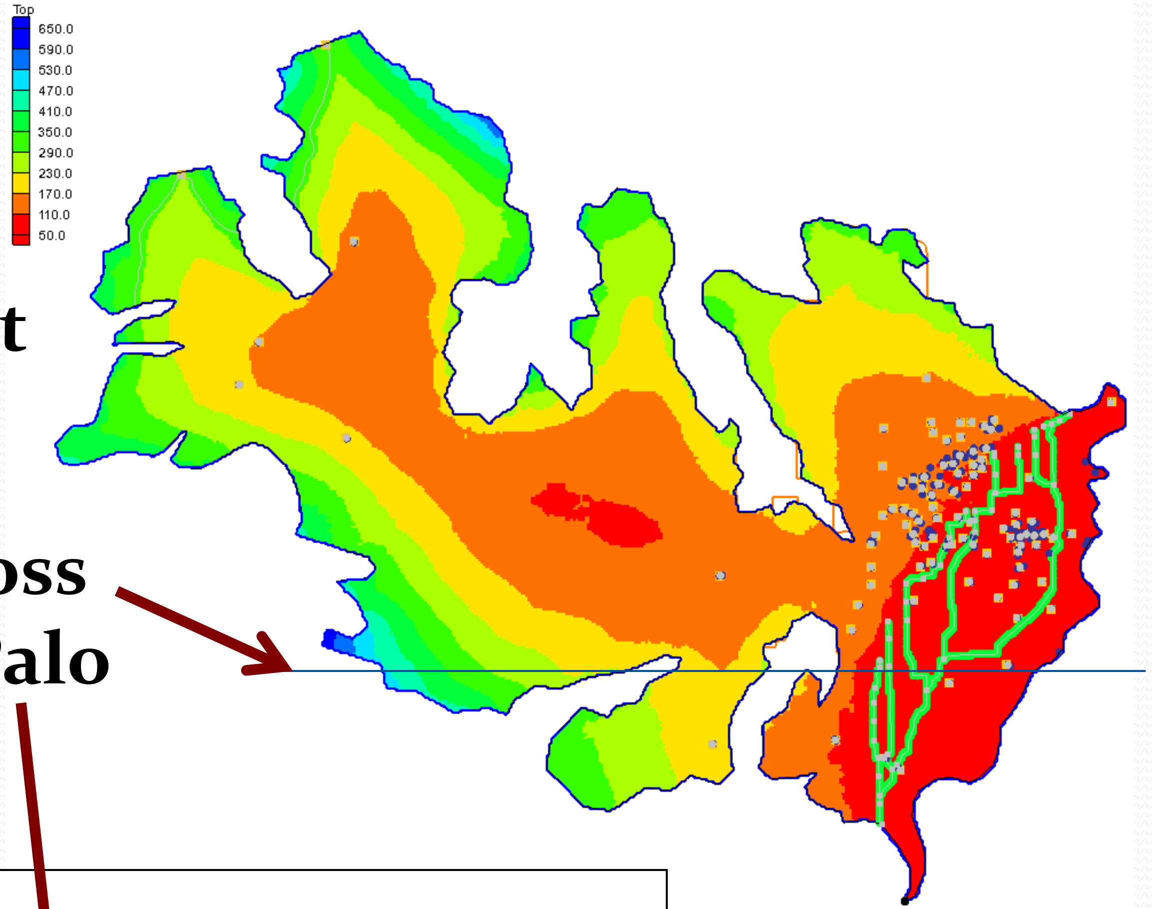
BLM-ANL Water Study

Modeled three post-2010 solar development scenarios:

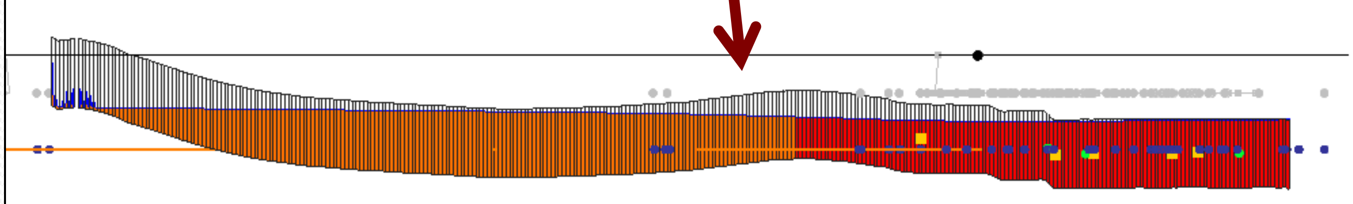
- **Low water usage (all PV)**
- **High water usage (all dry cooling solar thermal)**
- **Intermediate water usage (half of high level)**

Modeled 20 years of pumping, with Chuckwalla Basin recharge of 3,200 afy.

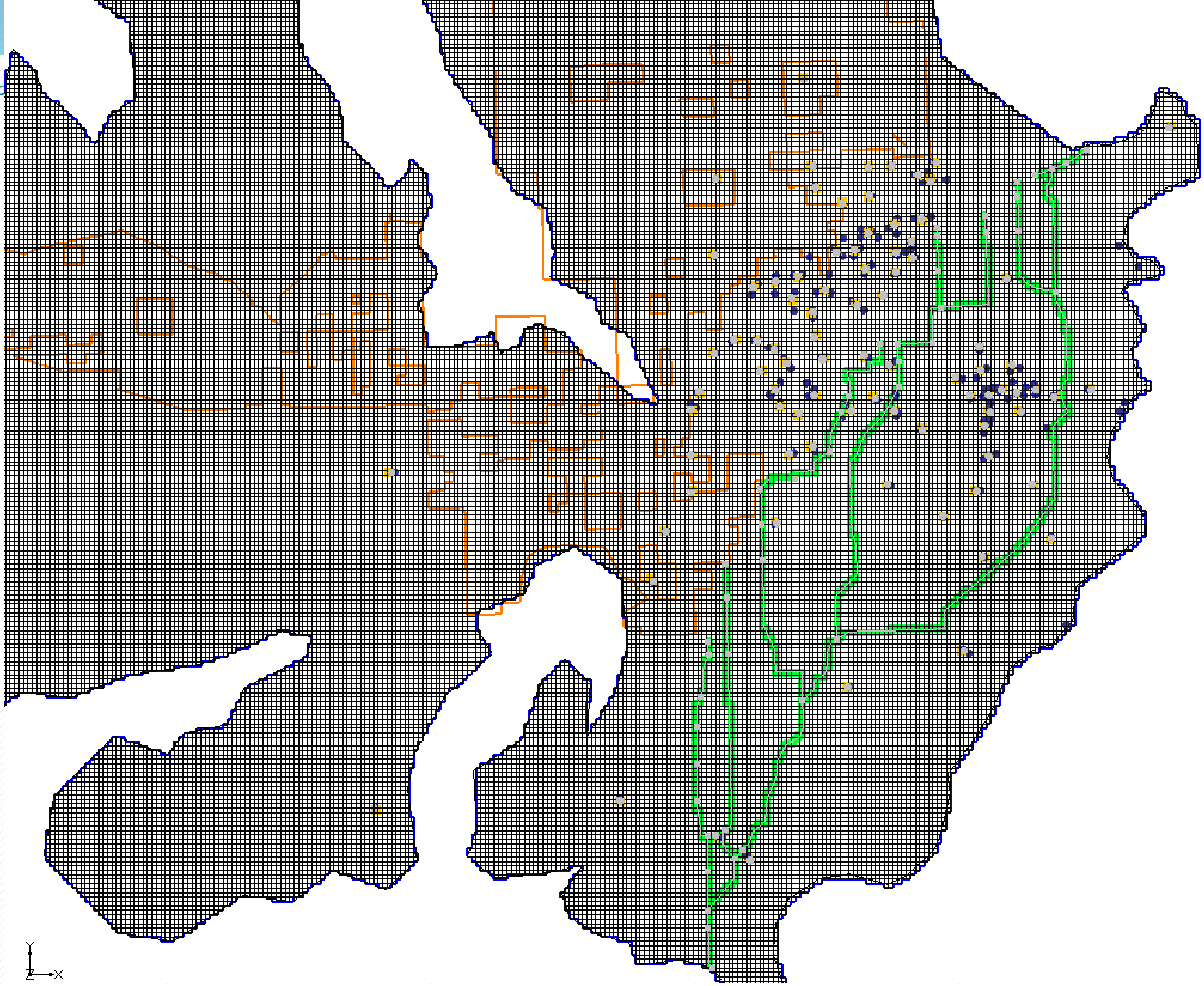
1-Layer Model



- Layer has constant thickness (600 ft)
- Cross-section across Chuckwalla and Palo Verde basins



Pre-1942 period



1-Layer Model:

200 x 200 m cells

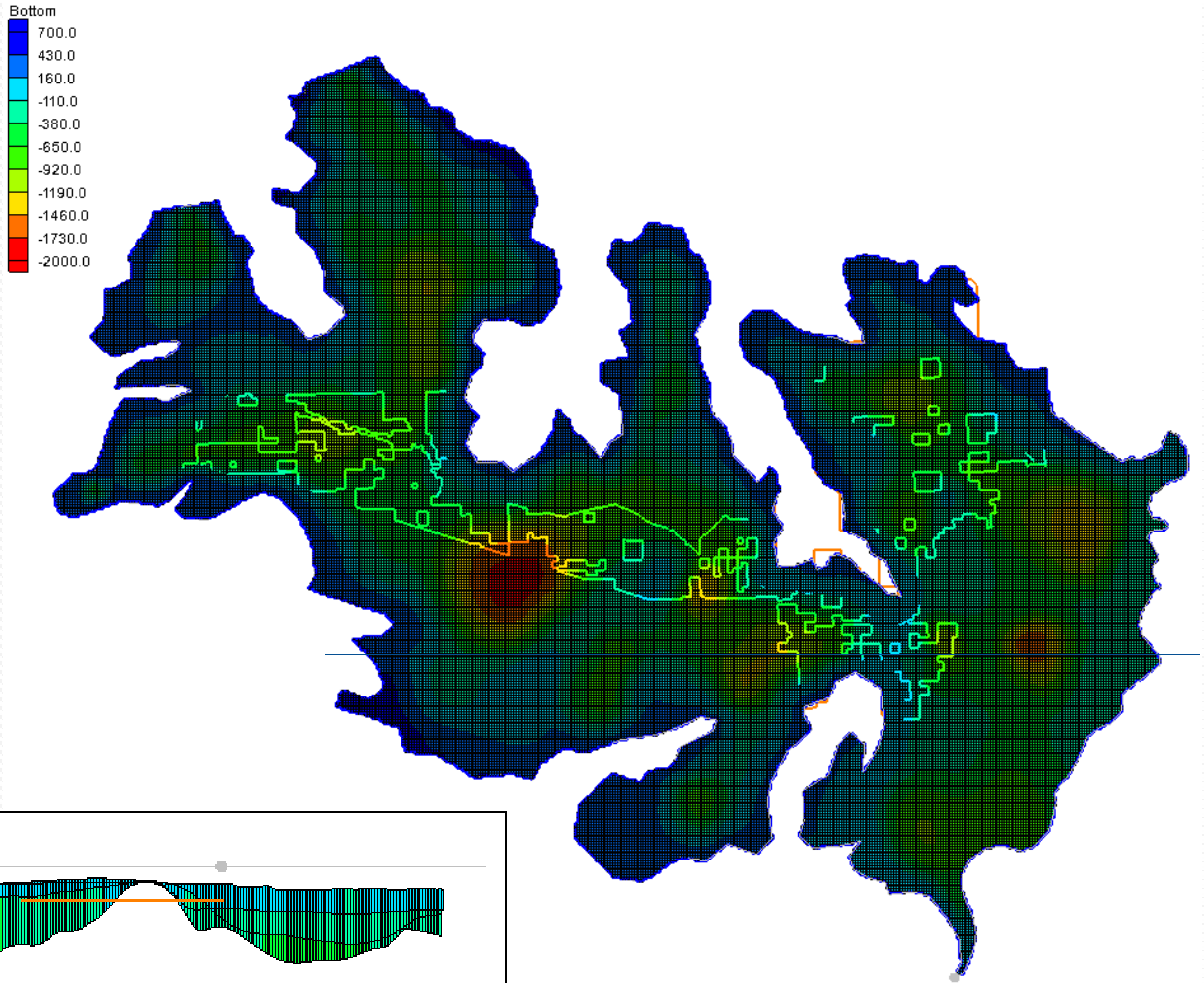
(660 x 660 ft)

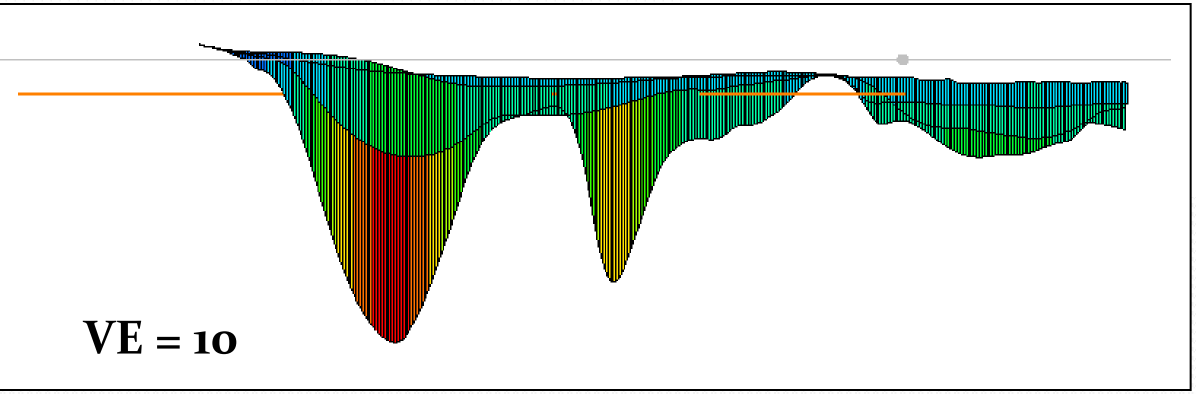
3-Layer Model

- Showed varying thickness of basins
- Modeled discharge from Chuckwalla Basin
- Modeled impacts to USGS Accounting Surface
- Increased drawdown accuracy
- Improved simulation of saline migration from under dry lakes

3-Layer Model

Bedrock surface based on USGS logs, gravity mapping, and Genesis Solar gravity modeling





BLM-LBNL Study

- Conducted 2013-2015
- Installation of new monitoring stations is a major component, to fill in data gaps
- Combined groundwater + surface water model
  - Groundwater dynamics in both saturated and unsaturated zones
  - Airborne dust and its impact on vegetation
  - Possible migration of dust control surfactants within the vadose zone

BLM-LBNL Water Study Goals

1. **Monitor water pumping and water table drawdown during construction and operation of solar projects.**

2. **Produce estimates of values for components of the water balance in the basin.**

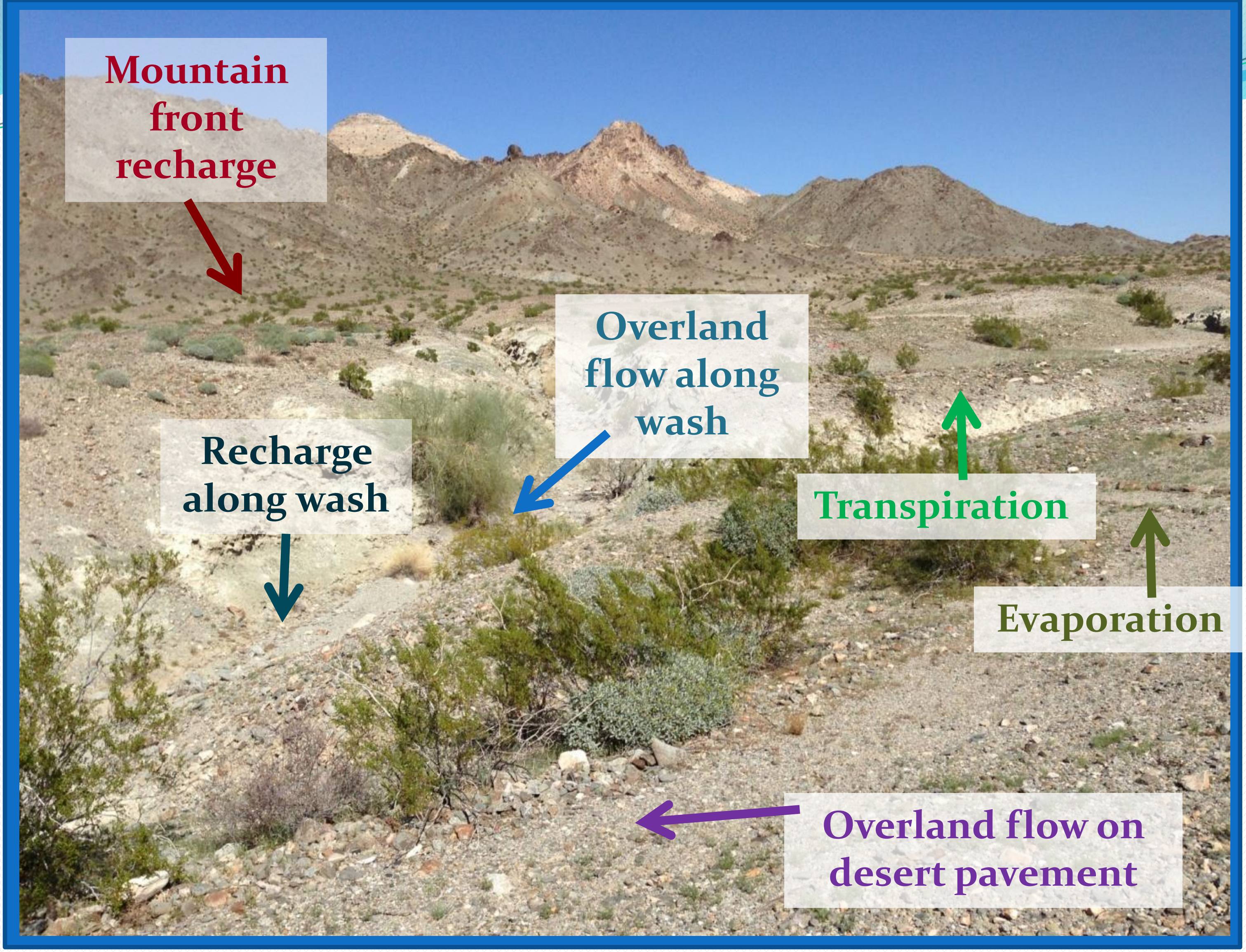
3. **Model basin hydrologic and vegetative processes to adjust preliminary estimates and projected impacts.**

4. **Apply lessons learned to energy projects in this basin and elsewhere.**

Data Collection

Climate and soil stations

Monitoring wells



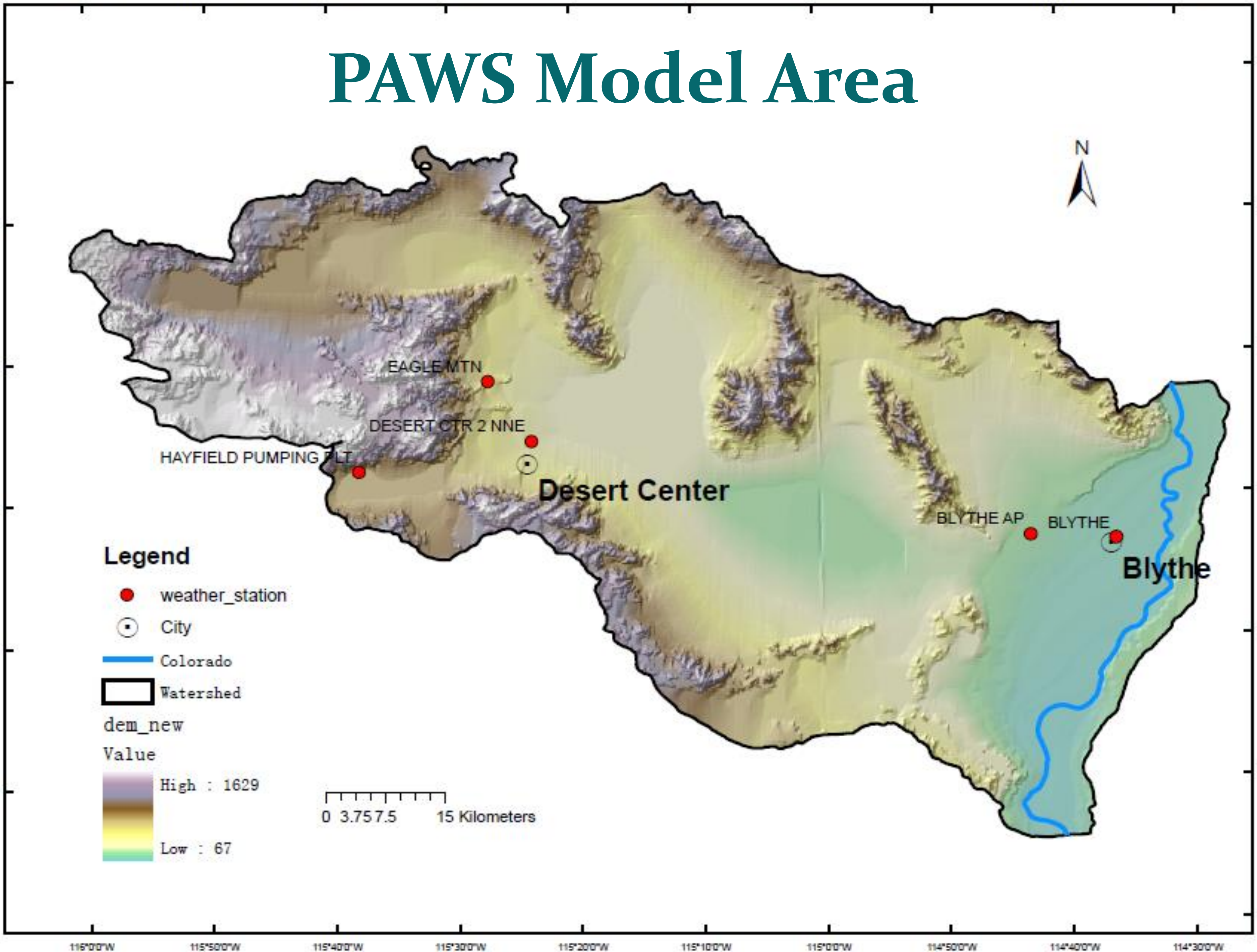
Subdivision of water balance components

LBNL Water Flux Model

- Developed at Pennsylvania State University, using the PAWS (Process-based Adaptive Watershed Simulator) model

- Results can be compared to ANL MODFLOW model to evaluate both models

PAWS Model Area

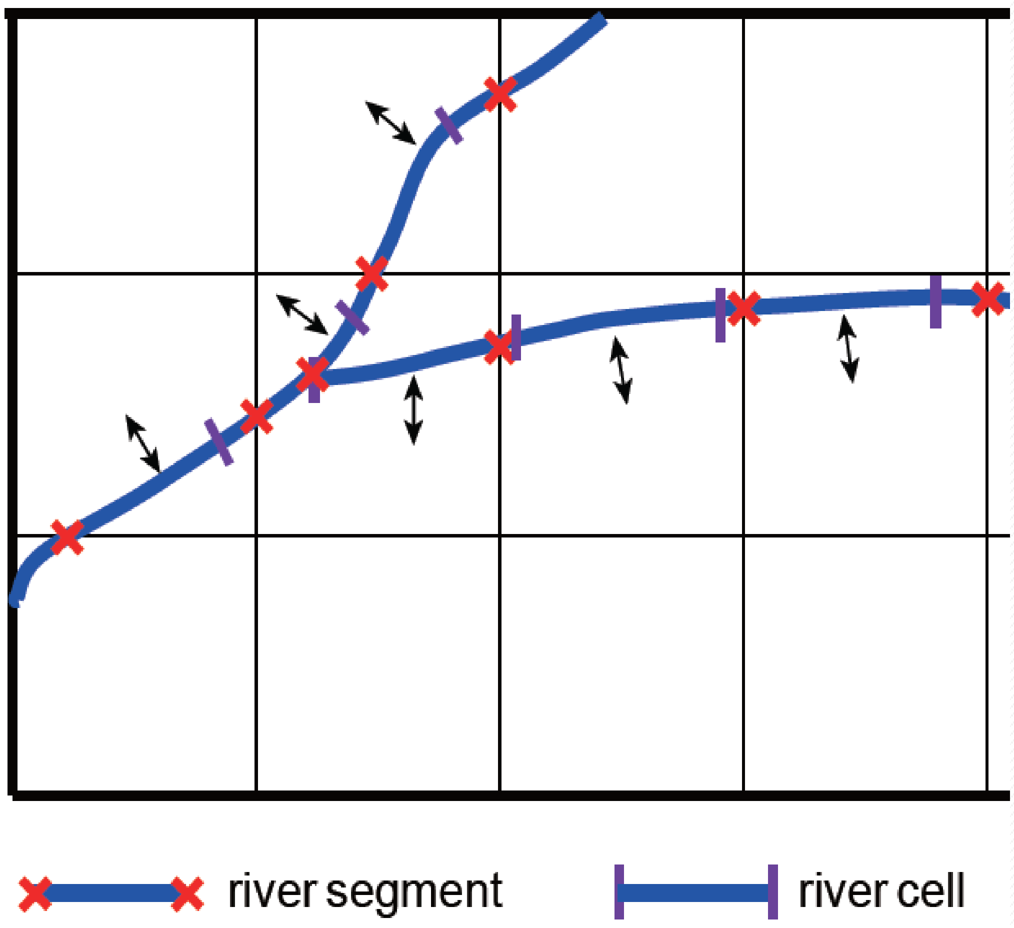


PAWS Model Features

- **Physical components**
  - **Surface water (overland flow and stream flow)**
  - **Subsurface water (unsaturated and saturated zones)**
  - **Daily variability in evaporation and transpiration**
  - **Currently 5 subsurface layers**

- **Vegetative components**
  - **Wetlands and their interactions**
  - **Daily photosynthesis and seasonal plant growth**
  - **Carbon and nitrogen fluxes**

PAWS Surface Flow



Representation of overland flow + channel network

Preliminary Model Results

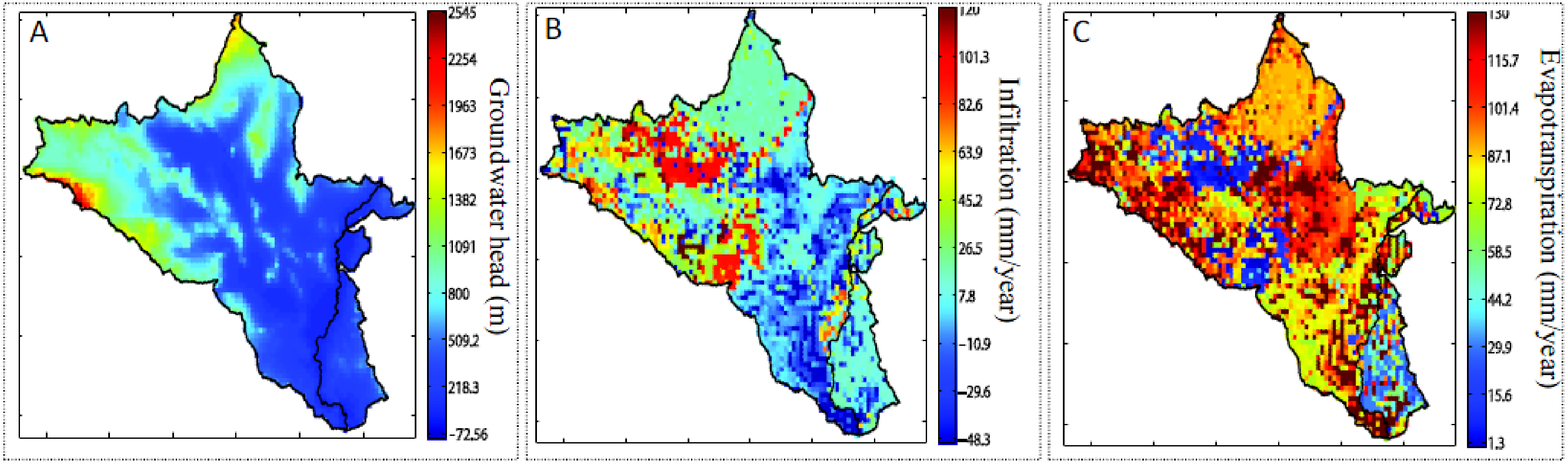


Figure 12. Initial modeling results from preliminary modeling effort providing estimates for A. Hydraulic head distribution, B. Infiltration and C. Evapotranspiration across the modeled domain.

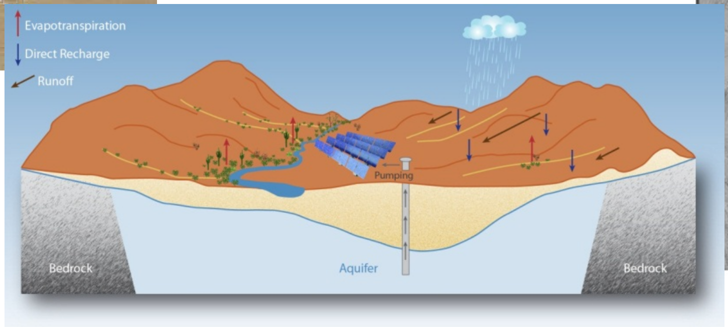
Expected Modeling Results

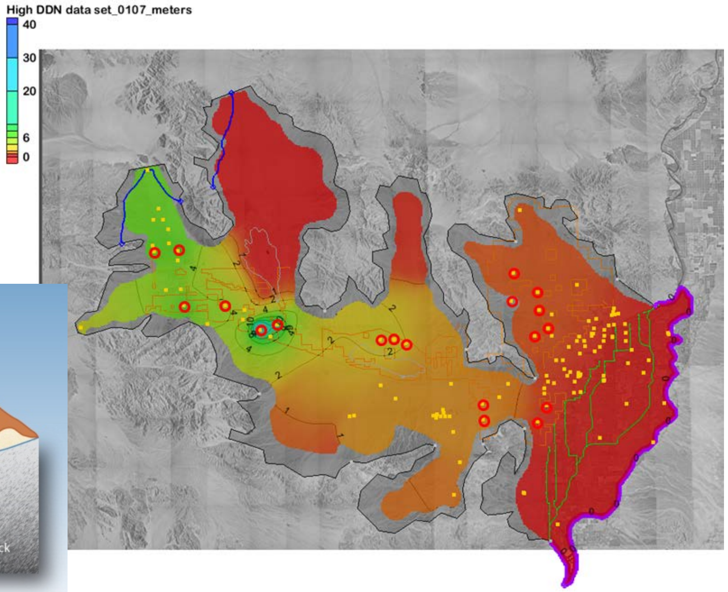
- 3D model of groundwater and soil water dynamics
- Changes to water table and groundwater flow patterns due to pumping by proposed development
- Pumping impacts on surface flow and vegetation
- Effectiveness of best management practices
- Tradeoffs between mitigation costs and impacts
- Impacts to recharge to the Colorado River

Thank you


WATER SUPPLY
LIMITED
DO NOT WASTE
NON-POTABLE WATER
SODIUM AND FLUORIDE CONTENT
EXCEEDS ESTABLISHED LIMITS.
LONG-TERM CONSUMPTION NOT RECOMMENDED

Modeling of Drawdown Impacts Associated with Solar Energy Development in the Southwestern United States

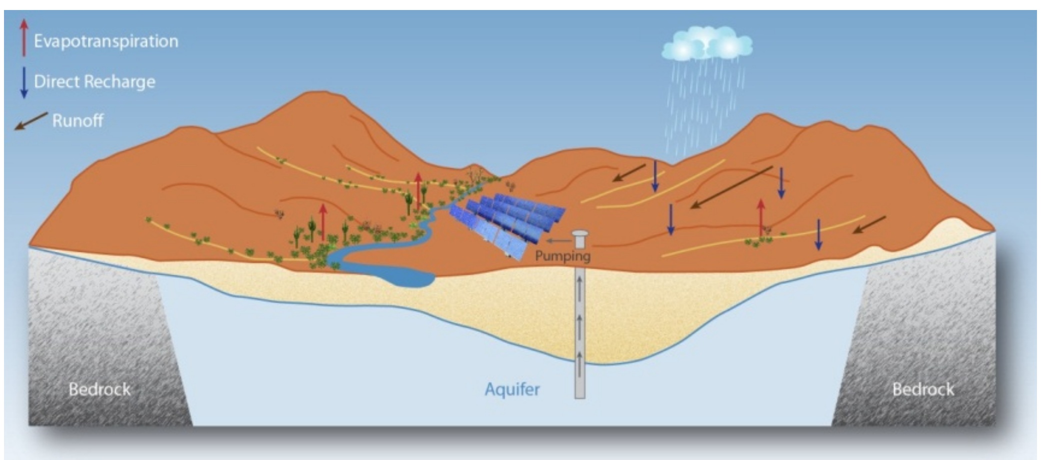




Chris Greer, John Quinn, Ben O'Connor
Environmental Science Division, Argonne National Laboratory

BLM Solar Energy Zones & Potential Water Impacts

- BLM Solar Energy Program
  - Impacts of reduced groundwater flow depend on connectivity of surface water and groundwater
    - Decreased water supply for other users
    - Loss of wetland vegetation species
    - Loss of habitat and forage for wildlife

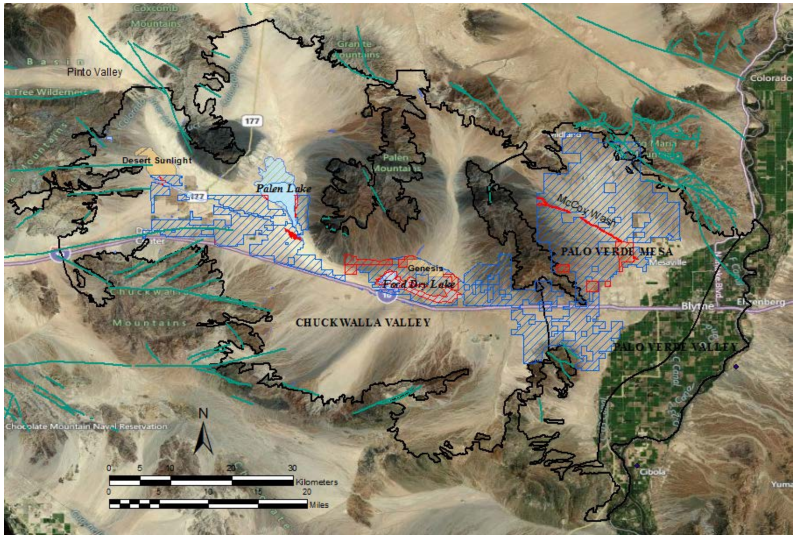


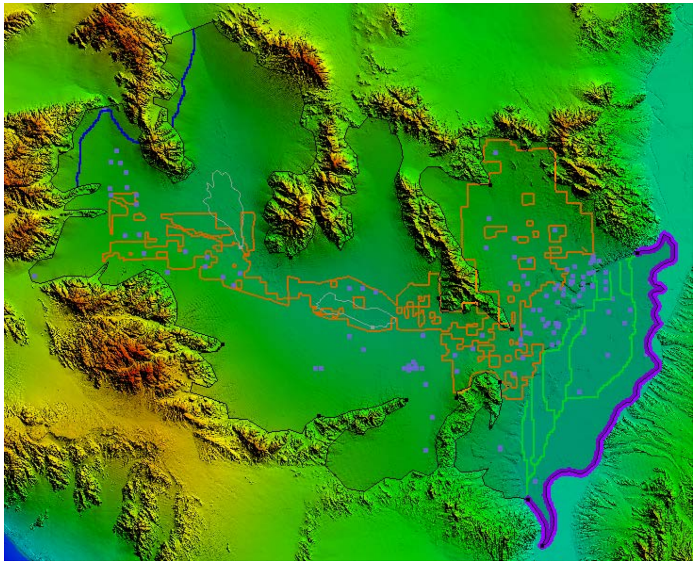
Riverside East (CA) – large, 600 km^2

Is within large alluvial basins (no regional carbonate aquifers).

Riverside East SEZ: 3-D Modeling

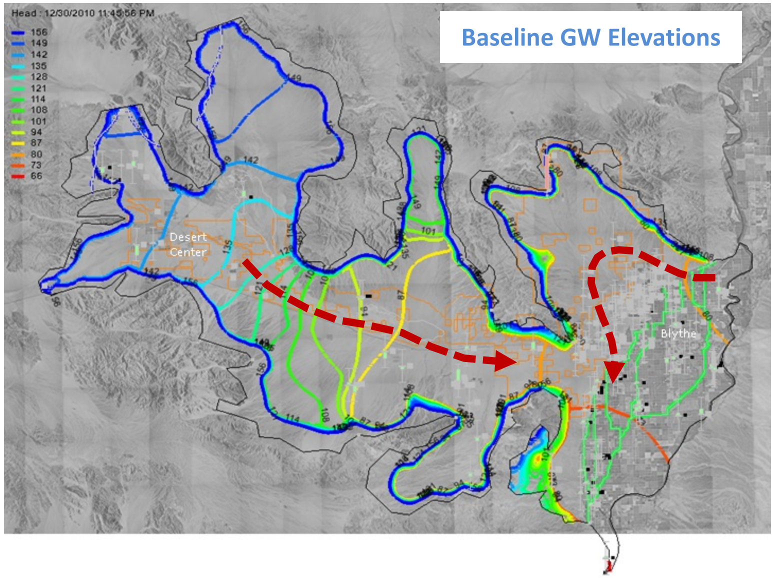
- Model Setup
  - Multiple recharge routes (natural, agricultural return, mountain front, basin inflow, Colorado River Aqueduct canal)
  - Colorado River and irrigation drains control groundwater elevations in east
  - Municipal, agricultural, and mining pumping

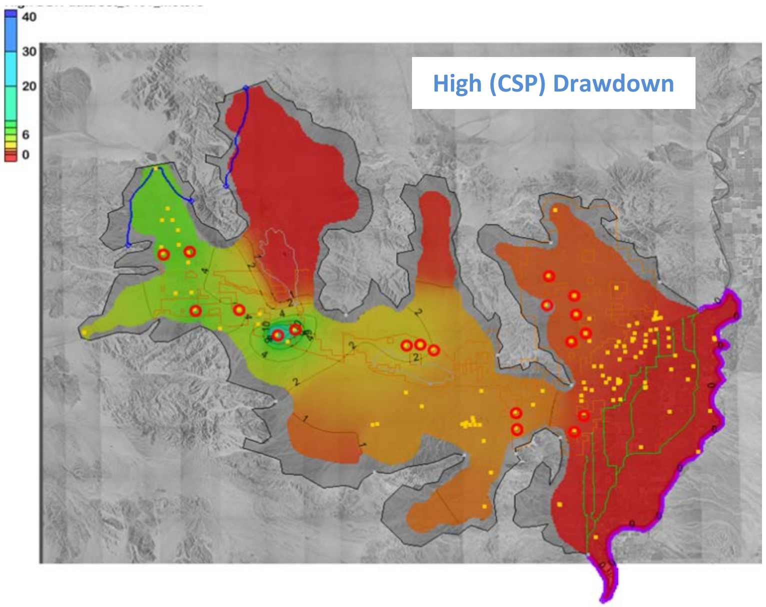


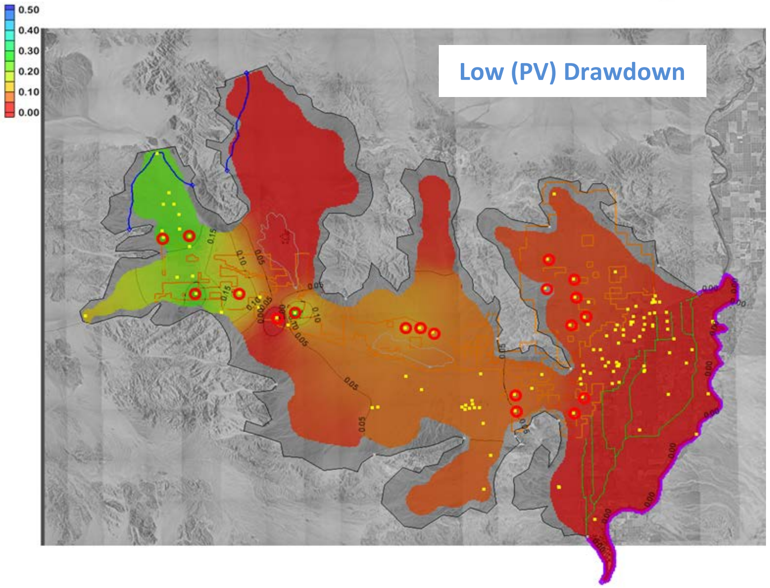


Riverside East SEZ: 3-D Modeling Results

- Future Scenarios (over 20 years)
  - Baseline: agricultural and municipal pumping
  - High demand: baseline and 9 CSP facilities
  - Low demand: baseline and 9 PV facilities







Preliminary Results

- 3-D models for Riverside East SEZ suggest maximum drawdown in western portion of SEZ and potential unknown water source in north eastern portion of SEZ that is potentially underestimating groundwater drawdown impacts
- Model suggests that low water demand scenarios (PV) have minimal groundwater impacts
- High and medium water demand scenarios can generate potential groundwater impacts that are dependent on water demand and hydrogeologic conditions (Transmissivity)
- Further hydrogeologic characterization is necessary to better characterize impacts

Remote sensing to support long-term environmental monitoring

Needs

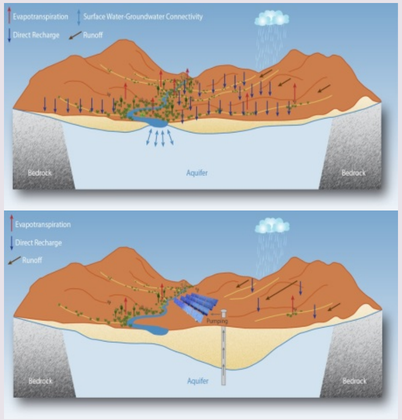
- Determine long-term impacts
- Determine the effectiveness of mitigation measures
- Assessing quantitative thresholds
- Cost effective data collection for a vast, remote region

Argonne National Laboratory is working for the DOE, Solar Energy Technologies Program and the BLM to support development of valid, cost-effective approaches to the long-term monitoring of environmental impacts of utility-scale solar development.

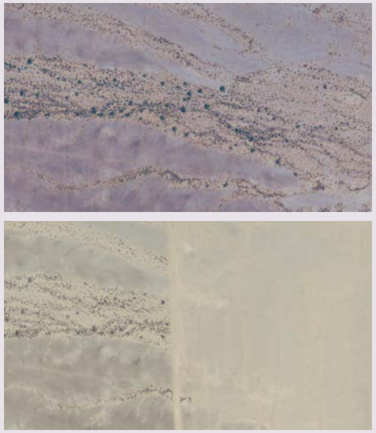
Goal & Objectives

Develop remote sensing approaches to support long-term monitoring for utility-scale solar energy development.

- Determine remote sensing metrics strongly associated with environmental parameters that are responsive to changing environmental conditions.
- Develop methods of linking remote sensing metrics and indicators of environmental impacts.



Example:
Impacts to hydrology from solar energy development

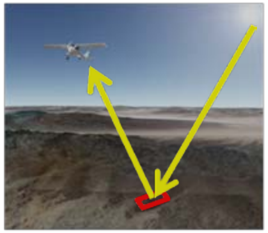


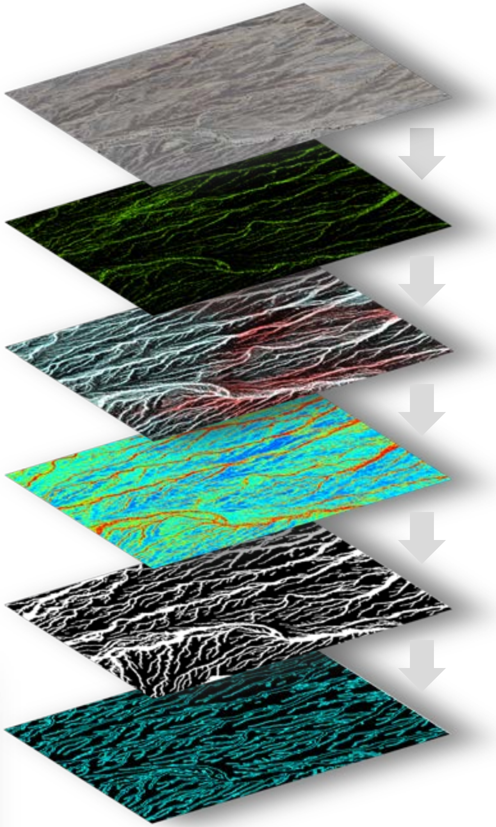
Example of impacts of initial solar energy development on riparian corridor

Remote sensing: Characterize surface hydrology

Accomplishments in 2013

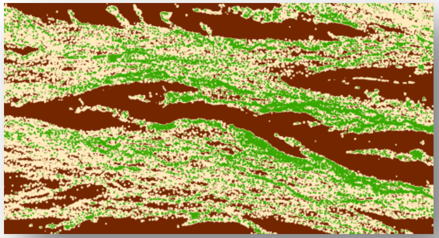
- Mapping ephemeral stream networks
  - Collected 15 cm Very-high-resolution (VHR) imagery
  - Extracted ephemeral stream channels using multi-scale data (aerial photographs and satellite data)
- Land surface characterization of vegetation density soil/surface types



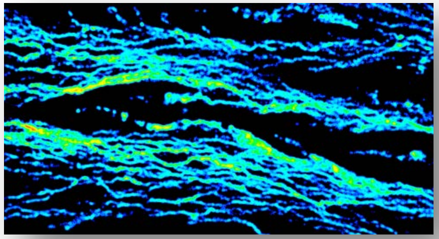


Ephemeral Channels

VHR image



Soil/surface types



Vegetation density

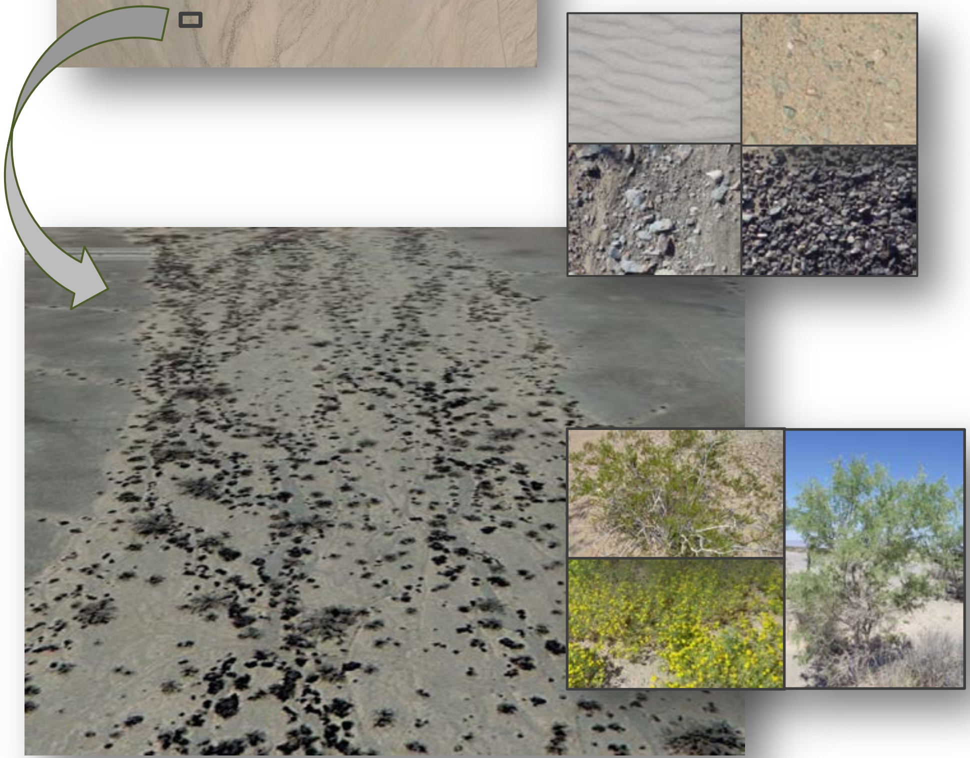
Remote sensing: Examine ecological habitats & communities – Plants and soils

Current Tasks

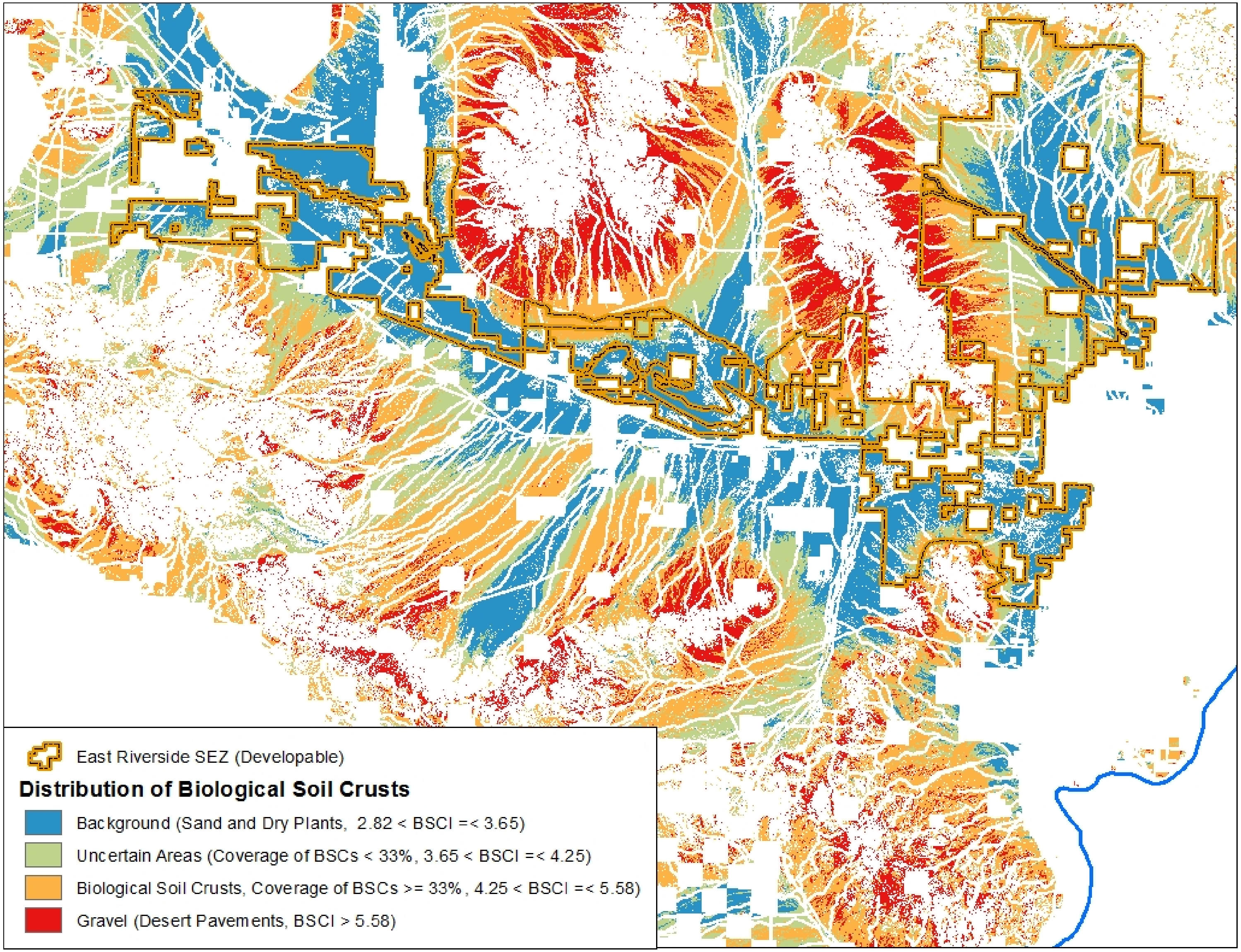
In FY14 we are focusing on vegetation and soil communities with the goal of developing RM capability for AIM core indicators

- VHR image collection of microphyll woodland
- Field surveys to further calibrate/validate RM algorithm for channel geometry, vegetation communities, vegetation cover, inter-canopy gaps, and soil texture
- Long term goal of developing cost effective remote sensing metrics responsive to environmental change

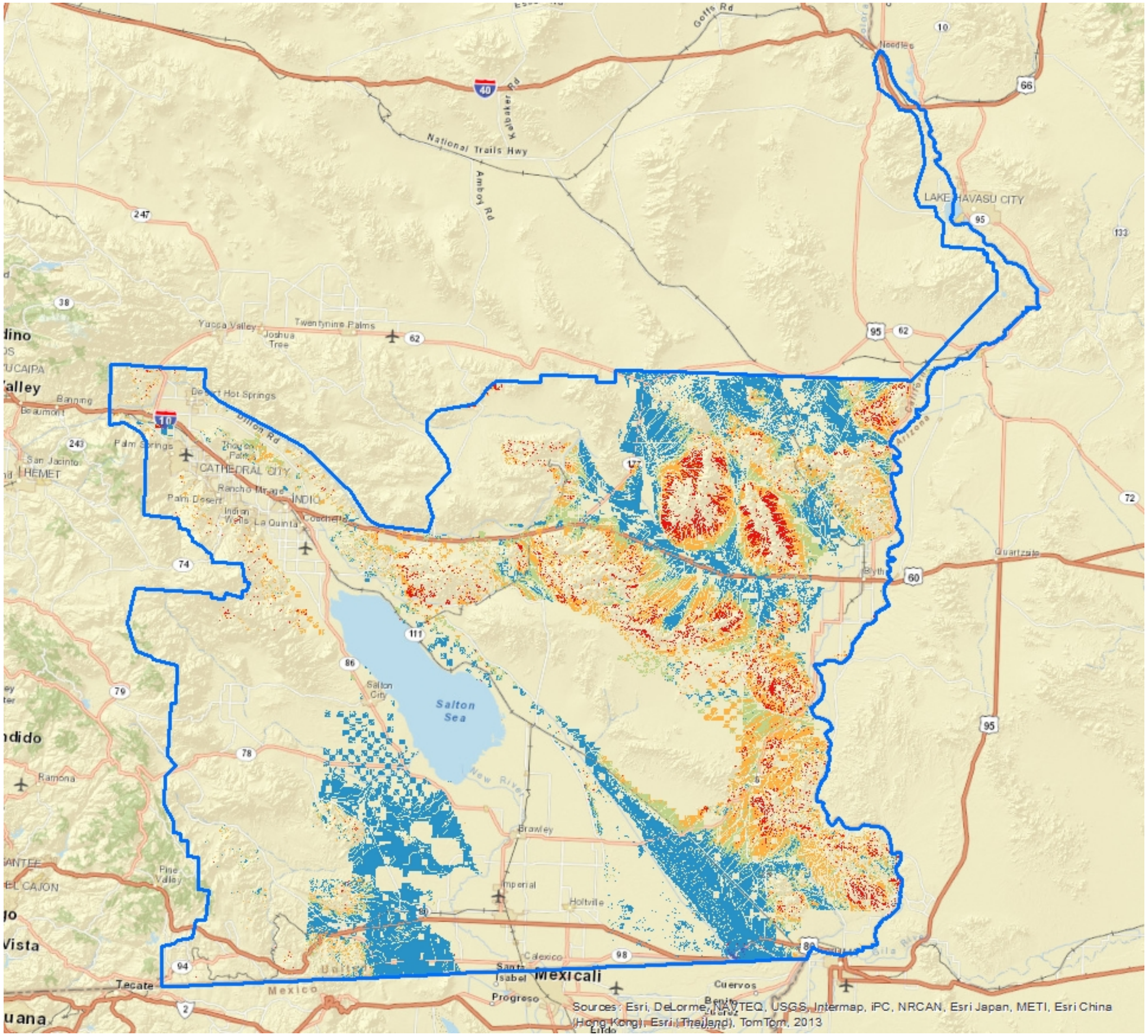
Riparian corridors in arid environments (Microphyll woodland within McCoy wash)

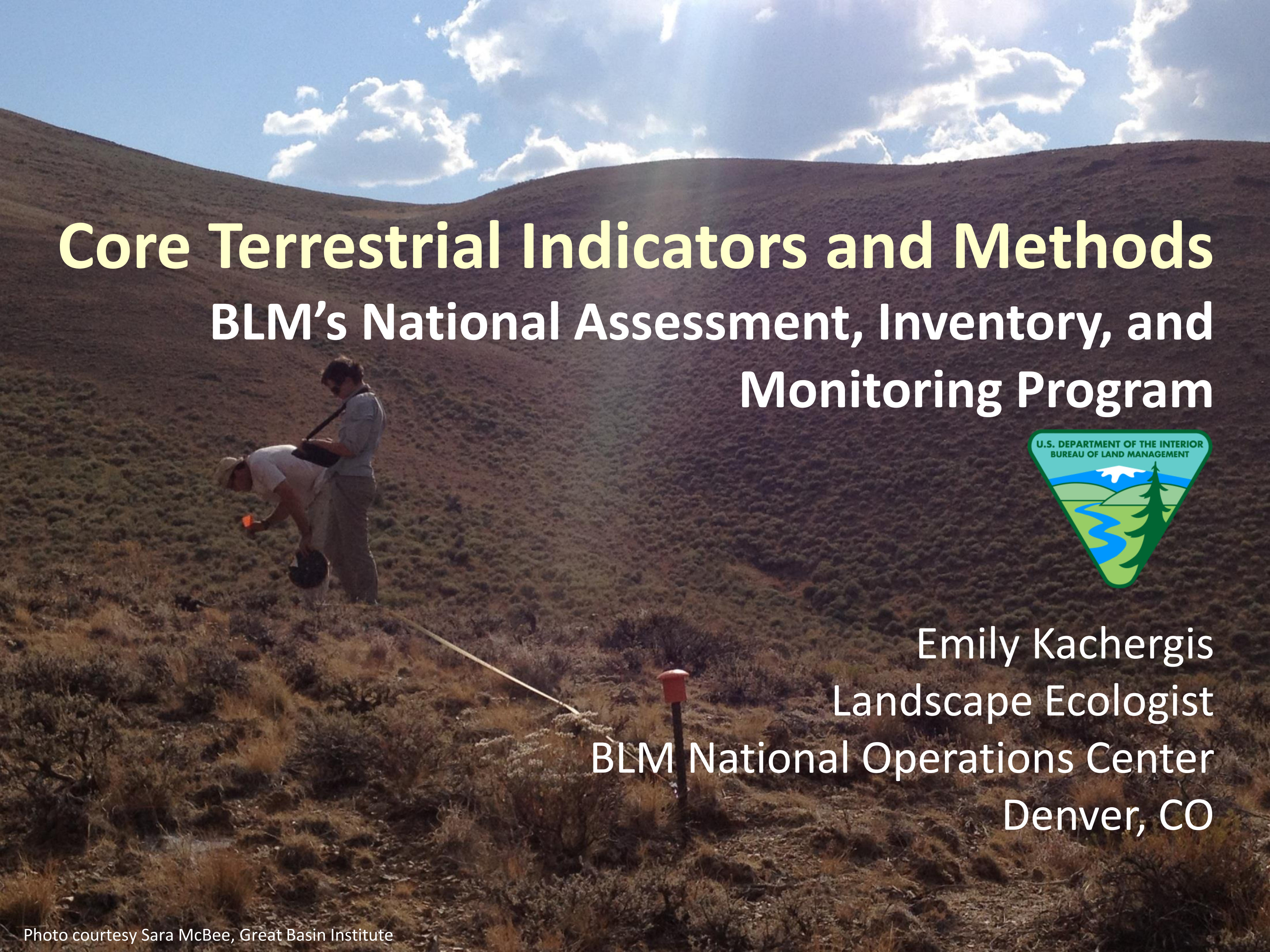


Remote sensing: Biological crusts



Remote sensing: Biological crusts





Core Terrestrial Indicators and Methods

BLM's National Assessment, Inventory, and Monitoring Program

Emily Kachergis
Landscape Ecologist
BLM National Operations Center
Denver, CO

Photo courtesy Sara McBee, Great Basin Institute

Management Question

Is solar-related water withdrawal affecting ecological structure and function?

Management Goal

Maintain groundwater dependent vegetation communities

Monitoring Objective

Allow for at most an X% loss in groundwater-dependent vegetation downstream of projects relative to baseline conditions

Attributes of Terrestrial Ecosystem Health

Soil and Site Stability

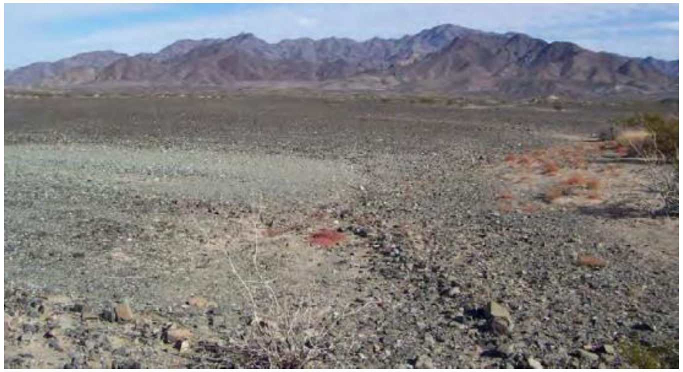


Photo: Menke et al 2013

Biotic Integrity

Photo: http://www.blm.gov/nstc/resourcenotes/rn16.html

Hydrologic Function

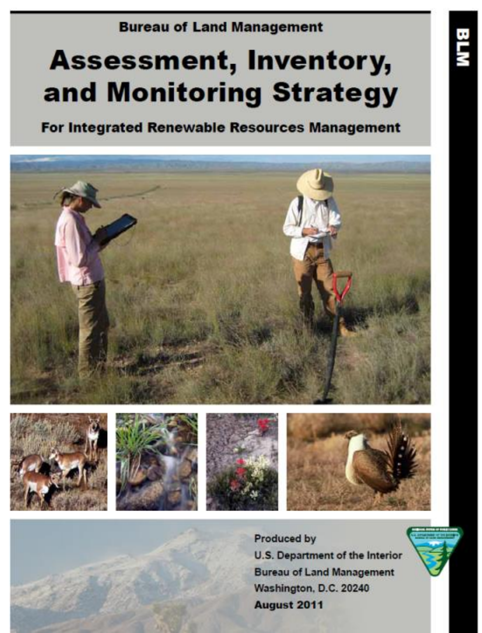
Photo: Menke et al 2013

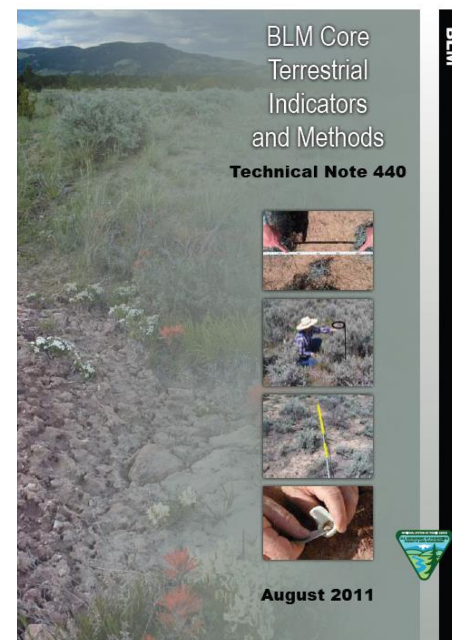
Landscape Metrics

Photo: Google maps

Choosing Core Terrestrial Indicators

- Review of national monitoring programs
  - NRCS National Rangeland Inventory (NRI)
  - USFS Forest Inventory and Analysis (FIA)
- Survey of natural resource experts
- External peer review

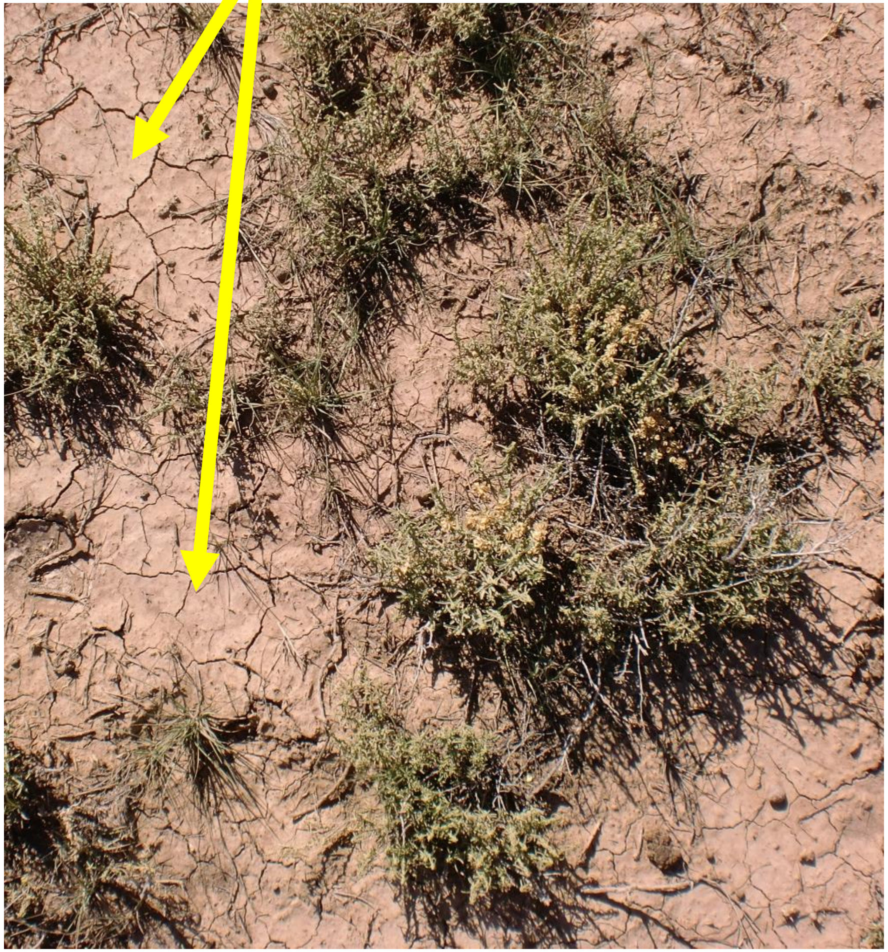




Core and contingent indicators for the Assessment, Inventory, and Monitoring Strategy and their recommended collection methods.

Type	Indicator	Method	Where applied?
Core	Amount of bare ground	Line-point intercept (LPI) supplemented with plot-level species inventory	All vegetation monitoring
	Vegetation composition		
	Non-native invasive species		
	Plant species of management concern		
	Vegetation height	Height at selected LPI points	All vegetation monitoring
	Proportion of site in large, intercanopy gaps	Canopy gap intercept	All vegetation monitoring
Contingent	Soil aggregate stability	Soil stability test	When soils are potentially unstable (most rangelands)
	Significant accumulation of toxins	Sampling for toxins in soil	When toxins are believed present (e.g., chemical spills)

Bare Ground



Example: 35% Bare Ground Cover

Photo: Emily Karchergis

Helps us understand:

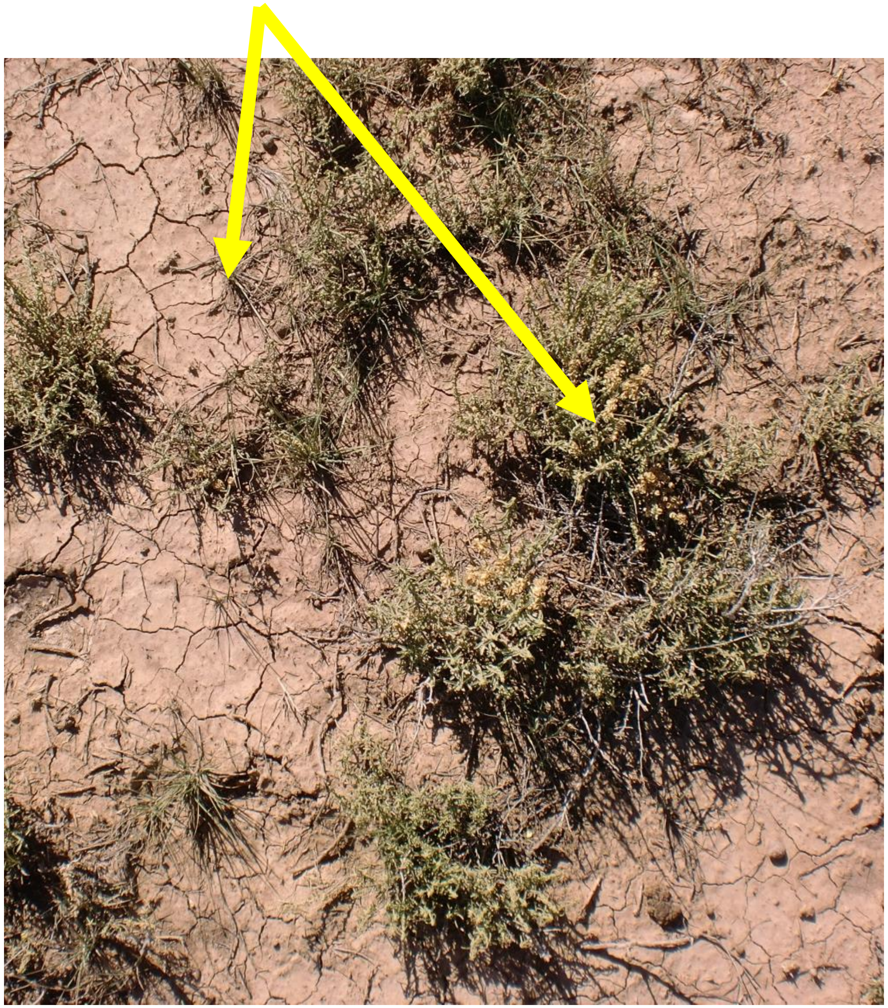
Erosion potential

Evaporation potential

Response to disturbance and management actions

Wildlife habitat

Vegetation Composition



Example: 10% Grass Cover;
20% Shrub Cover

Photo: Emily Karchergis

Helps us understand:

Plant community state

Response to disturbance and management actions

Plant productivity

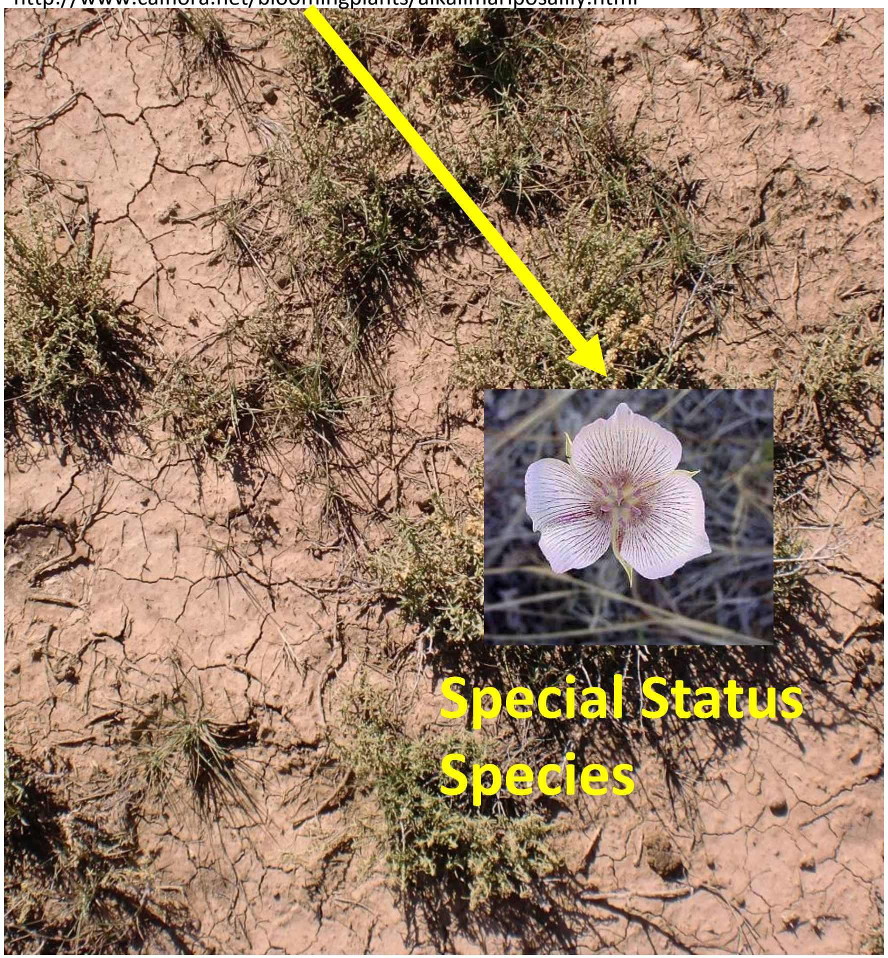
Erosion potential

Wildlife habitat

- Cover
- Forage

Plant Species of Management Concern

Photo: Emily Karchergis Mariposa Lily:
http://www.calflora.net/bloomingplants/alkalimariposalily.html



Example: Special Status Species is present

Helps us understand:

Abundance and distribution of Plant Species of Management Concern

Nonnative Invasive Species

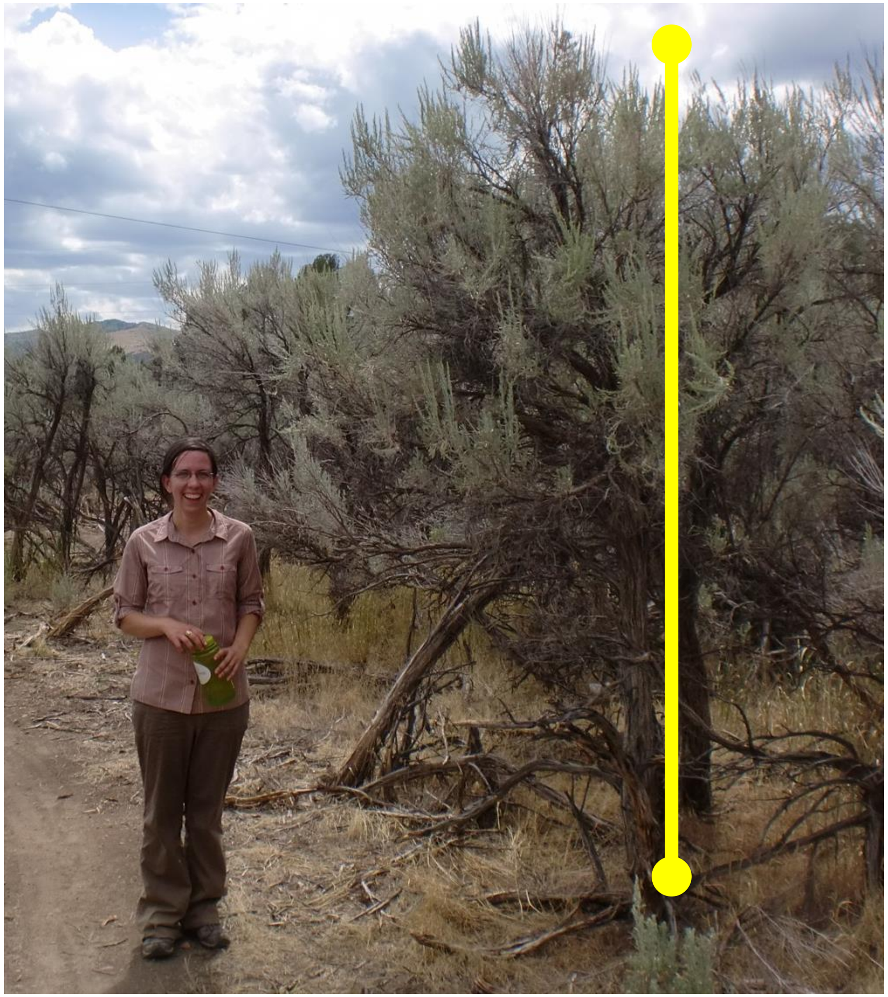
Example: 10% Cover of nonnative invasive species

Helps us understand:

Abundance and distribution of Nonnative Invasive Species

Photo: Emily Karchergis;
Tamarisk: http://www.desertmuseum.org/programs/images/Tamchi1624020.jpg

Vegetation Height



Example: Sagebrush is 180 cm tall

Photo: Emily Karchergis

Helps us understand:

Wildlife habitat

- Cover
- Forage

Erosion potential

Canopy Gaps

Example: 20% Cover of Canopy Gaps >20 cm

Photo: Emily Karchergis

Helps us understand:

Wildlife habitat

- Cover

Erosion potential

Hydrologic function

Plot Layout

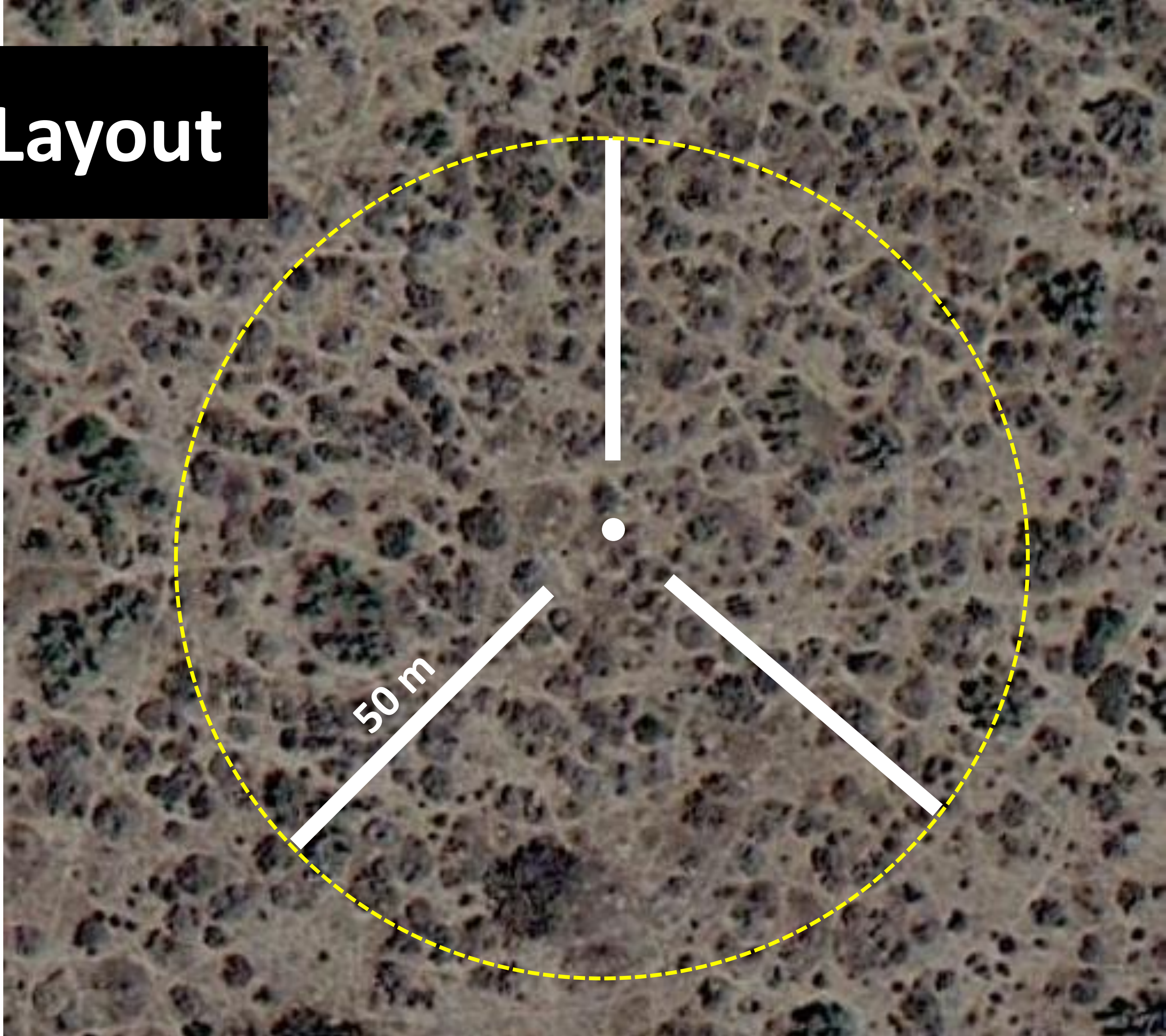


Photo: Google maps

Methods for Core Indicators

Line Point Intercept…

Photo: Emily Karchergis

Bare Ground

Vegetation Composition

Plants of Mgmt. Concern

Nonnative Invasive Sp.

…with Height

Photo: http://www.blm.gov/id/st/en/prog/grazing/managing_grazing_in/monitoring_range_conditions.html

Height

Gap Intercept

Photo: Herrick et al. 2005

Canopy Gaps

Example Application:
Jackson Mountains, NV

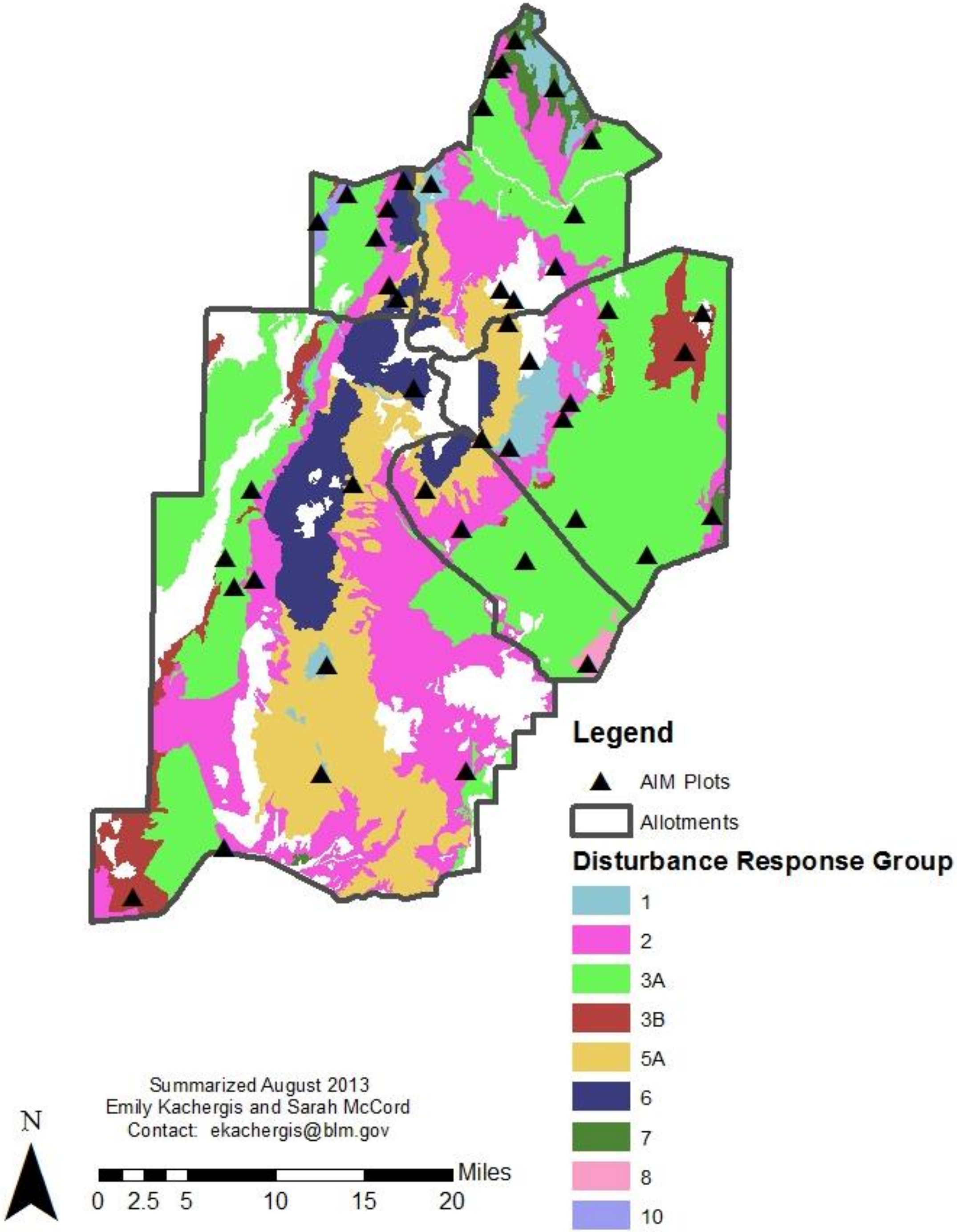
Photo courtesy Jocelyn Karsk

Management Question: What is the status of resources in the Jackson Mountains, NV?

Example Application:
Jackson Mountains, NV

Photo courtesy Jocelyn Karsk

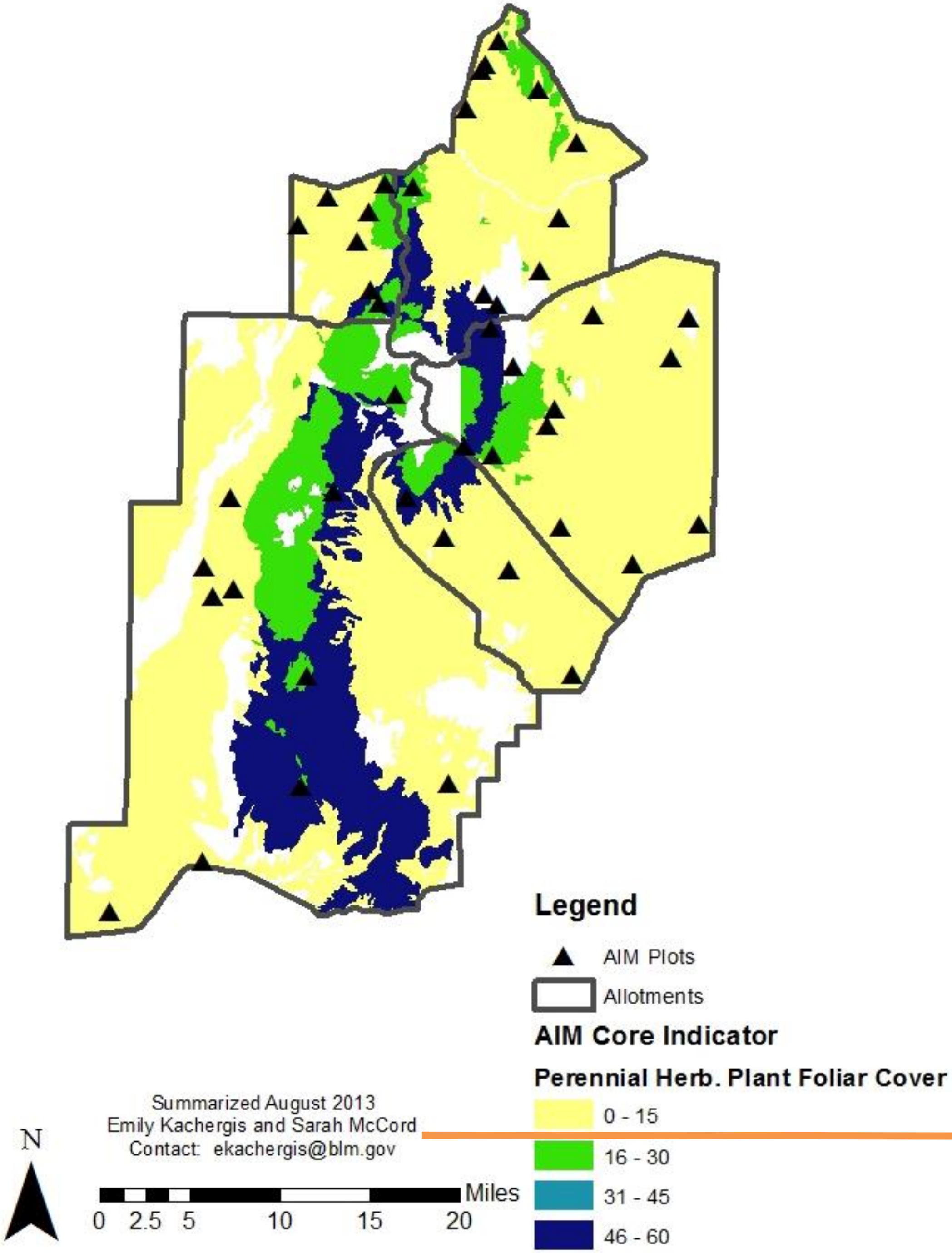
Example Objective: Herbaceous plant cover on all ecological sites in the Planning Area remains above 15% after 10 years with 80% confidence



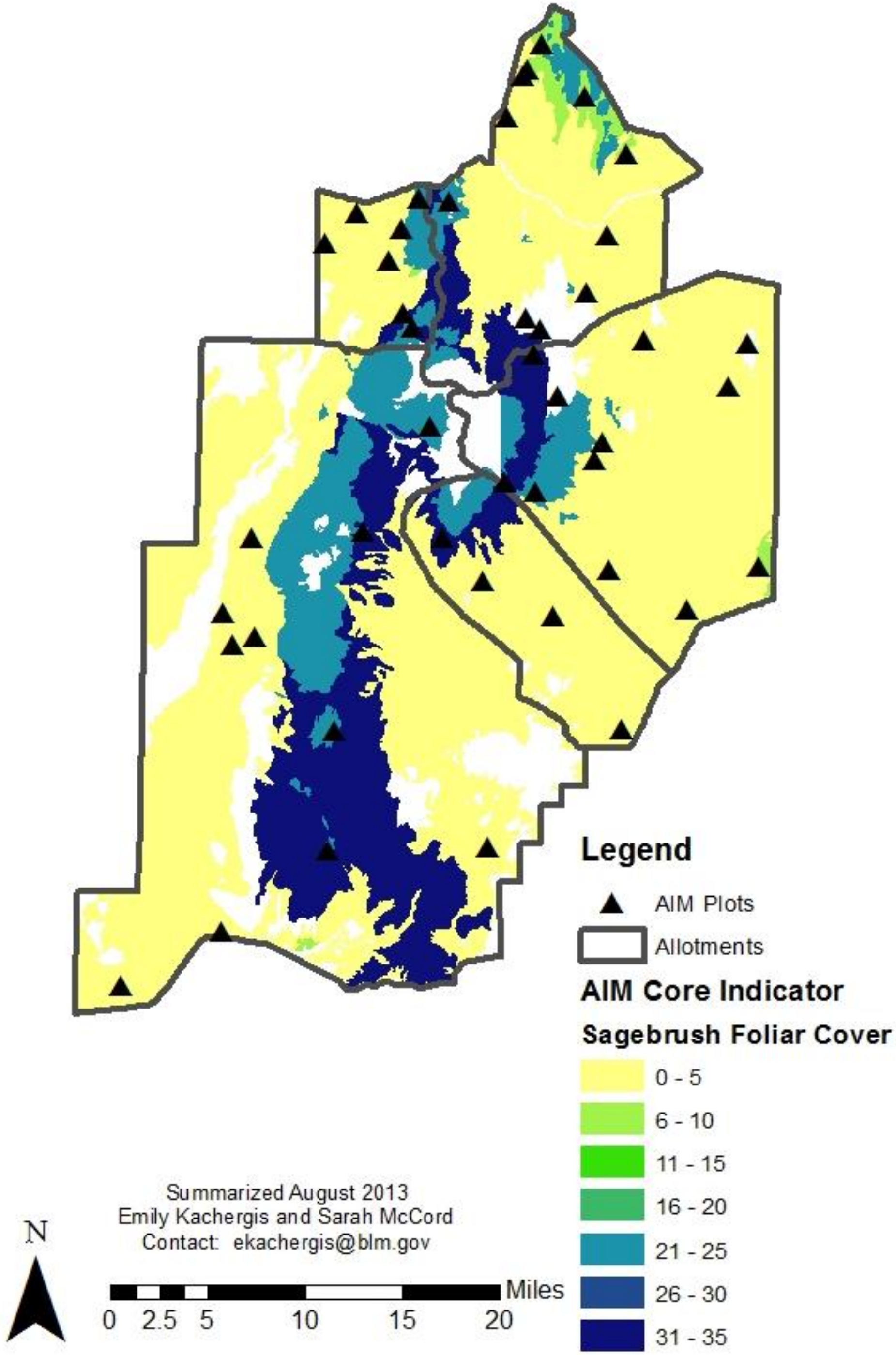
Disturbance Response Groups

(similar ecological sites)

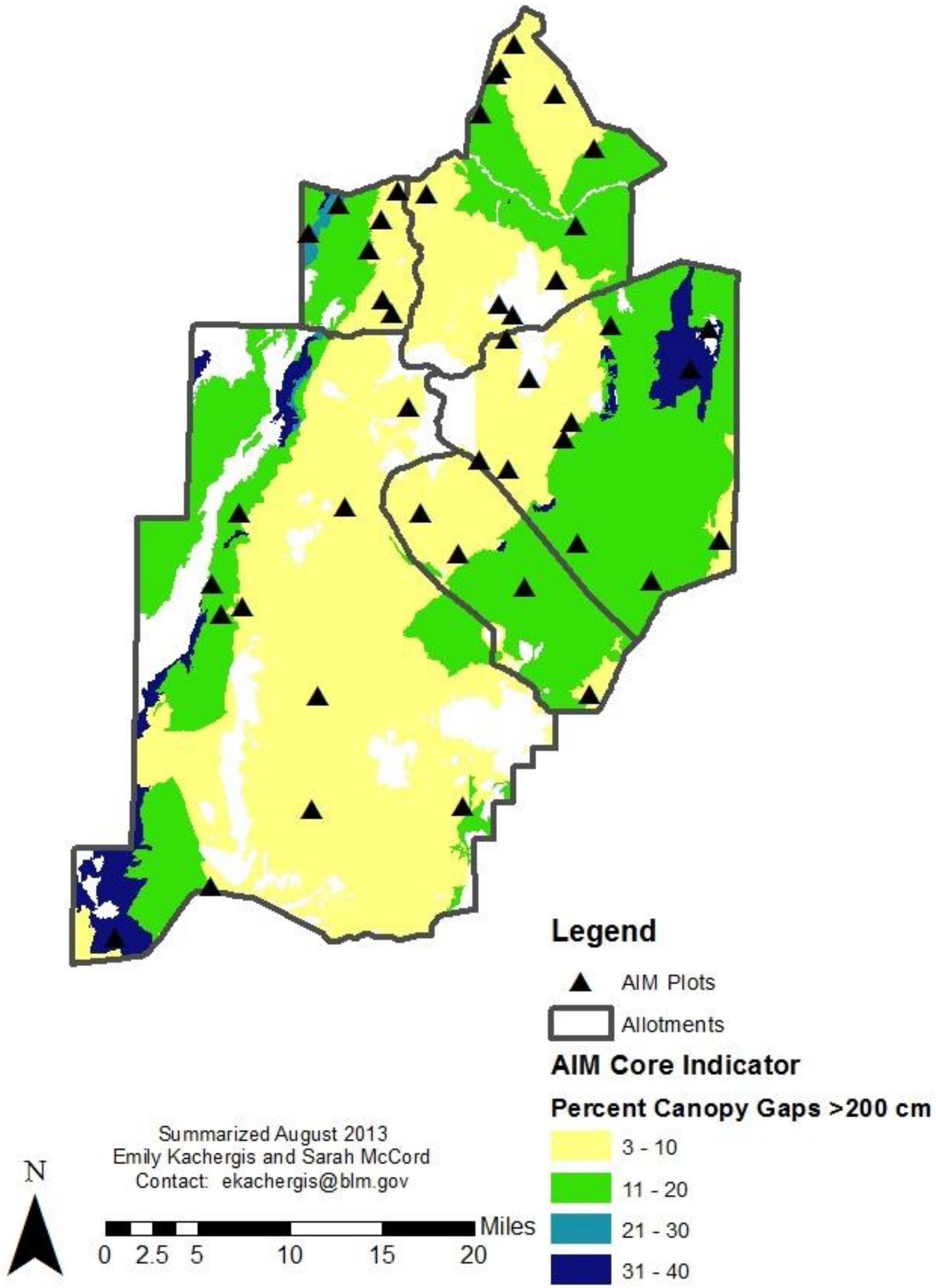
Herbaceous Plant Foliar Cover by DRG



Objective: >15%

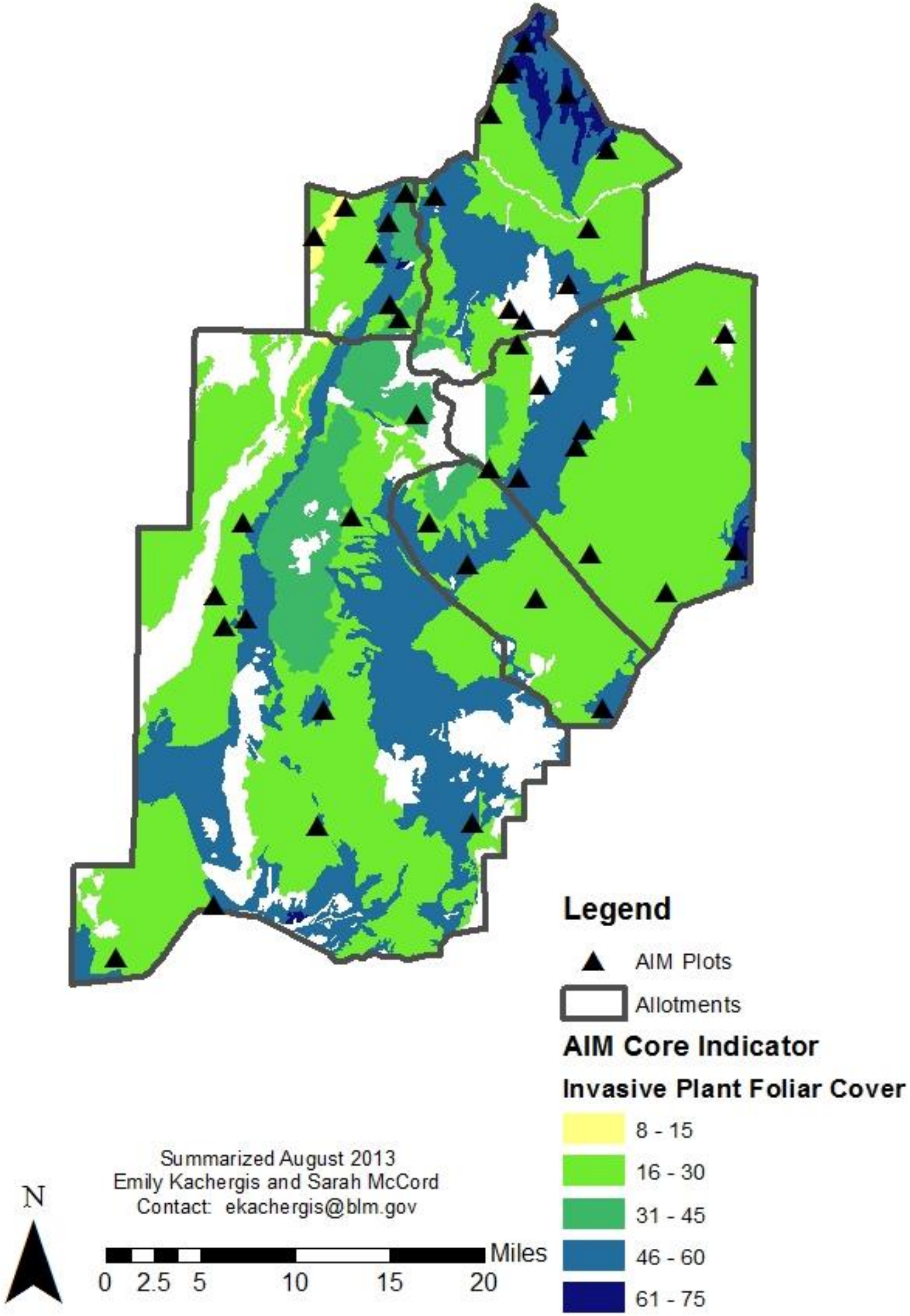


Sagebrush Foliar Cover by DRG

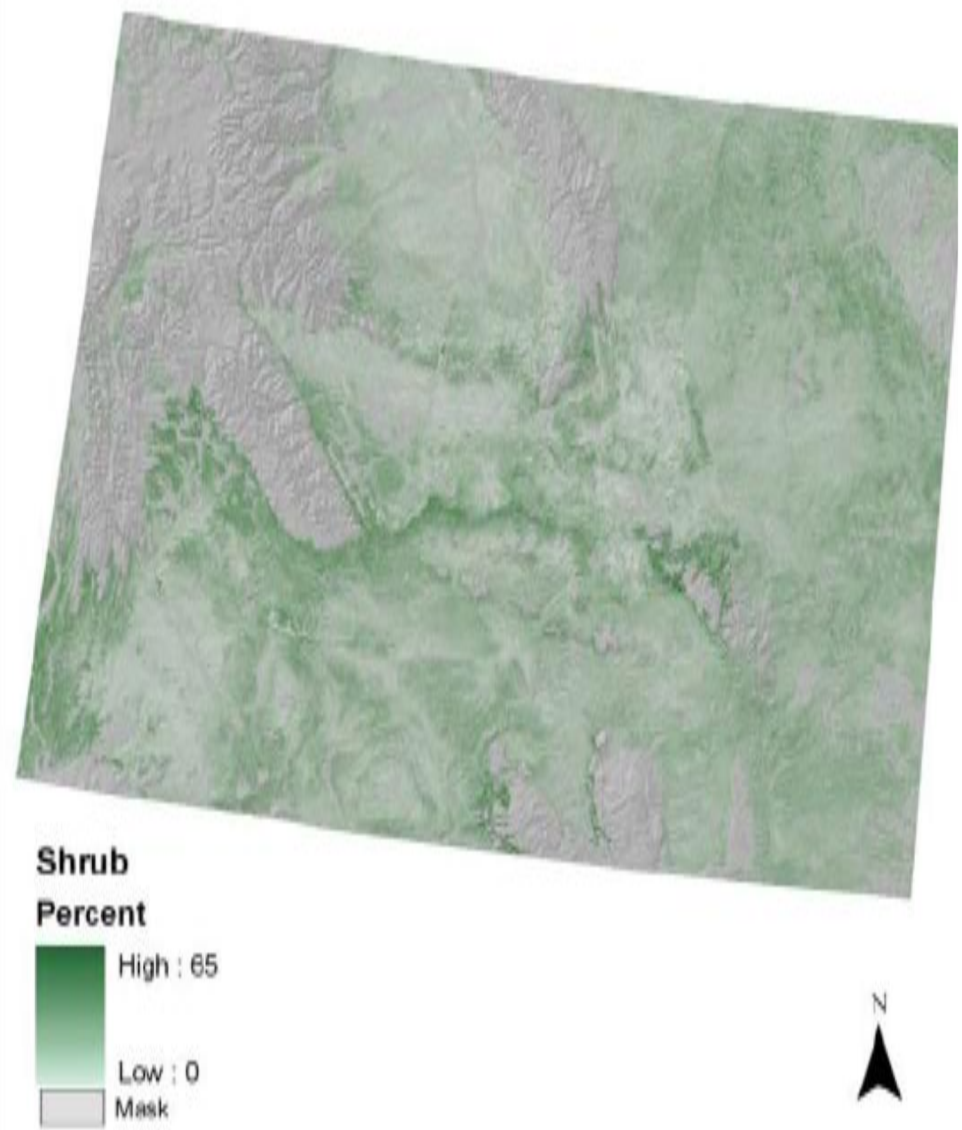


Bare Ground Gaps >200 cm by DRG

Invasive Plant Foliar Cover by DRG

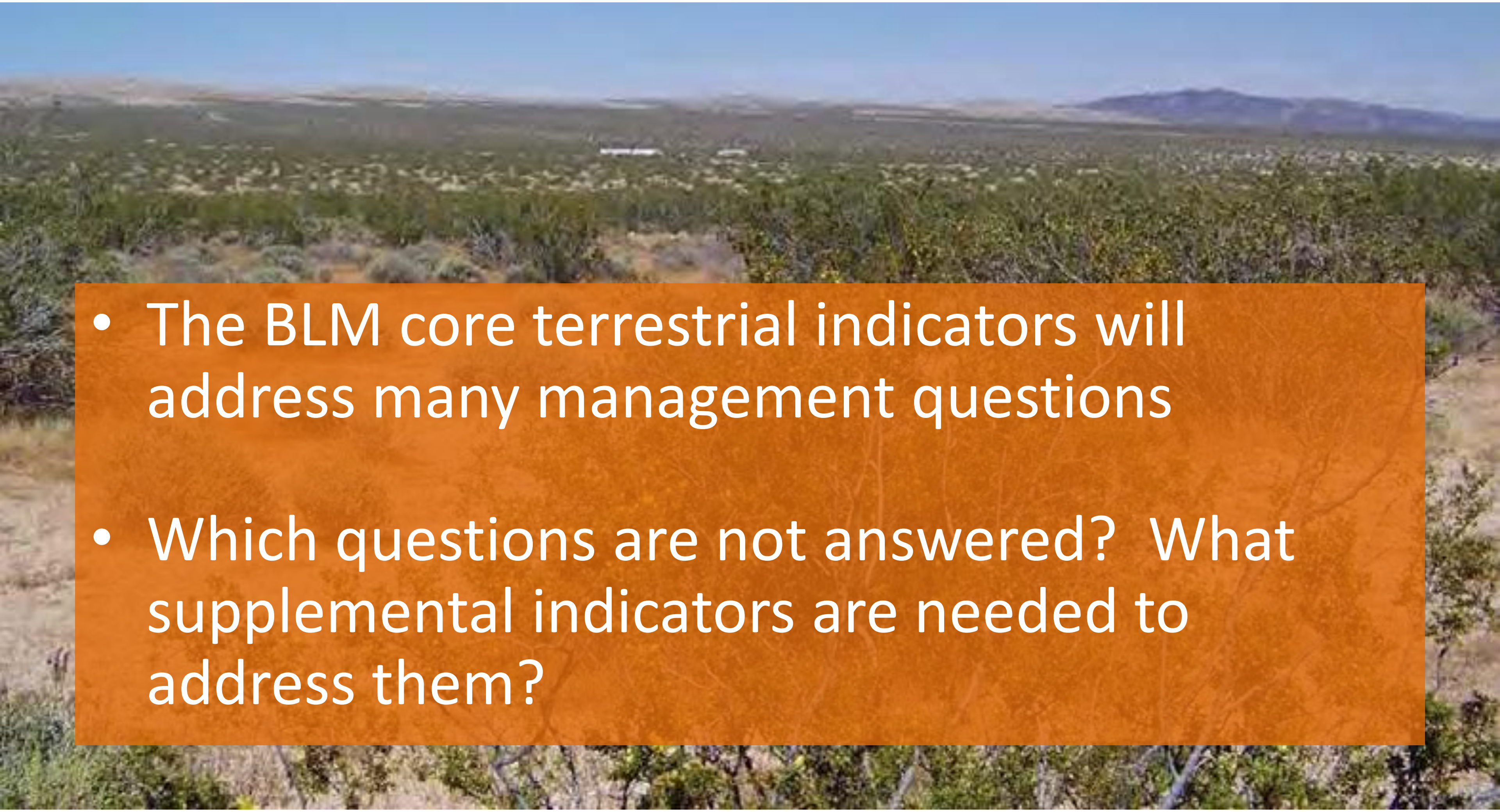


Linking Plot Data to Remote Sensing



Mapping Vegetation Composition in Wyoming

Closing Thoughts



- The BLM core terrestrial indicators will address many management questions
- Which questions are not answered? What supplemental indicators are needed to address them?

Photo: Menke et al 2013

Questions?

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Photo: Emily Karchergis

Breakout Group Discussion Summaries from Day 2

Based on identified management questions, are the BLM's preliminary monitoring objectives for the Riverside East SEZ appropriate?

- There are too many things listed and need to prioritize.
- Groundwater should be at the top of the list, it impacts many other resources.
- Visual impacts may be significant and should be monitored; recommend particulate monitoring and visibility studies.
- Additive monitoring, not duplicative
- What is the scale of the monitoring effort?
- Where to monitor?
- A lot of discussion on mitigation, developing mitigation is not on this list. There is a close connection. New mitigation may be identified during this process.
- Define "habitat connectivity"
- The monitoring objectives handout is a lot to digest in a few minutes.
- Need early warning indicators so corrections can be made before damage occurs
- Focus should be on high resource area vs. random sample design
- What is the purpose of the monitoring? How will the information be used?

Should the BLM include other monitoring objectives?

- Effect of solar related avian mortality on bird populations
- Use Before/After Control/Impact BA/CI studies
- Include plant phenology and condition
- Use data from existing SEZ studies
- Evaluate ephemeral washes evaluation
- Look at wildlife corridors
- Impacts of climate change
- Atmospheric visibility
- Increased visitation
- Species targets and DRECP
- Cumulative impacts for military operations
- Human elements needs more specificity
- Separate human health from economic indicators
- Monitor changes in minority incomes and housing costs
- Evaluate potential health effects
- Be more specific, (i.e., species to monitor)

Has anything you heard today changed your thoughts on monitoring program priorities?

- Too many priorities
- Birds
- Invasive species
- Hydrology/erosion/ groundwater
- Trails
- Archeological resources
- Monitoring the monitoring. Effectiveness.
- Careful linkage of the facility compliance monitoring and the regional monitoring.
- Find and integrate existing data sources. Motivation of sharing data is to save money.
- Life cycle of the monitoring, effectiveness of mitigation efforts, how will the objectives be initiated over scales.

- Dust
- Human development
- Glare
- Air quality
- Special status species

How can BLM maximize efficiencies of the monitoring program? E.g., building partnerships, establishing indicator species, using information to answer multiple questions.

- Funding, where is the funding coming from?
- Partnerships: Desert Management Groups, NPS (Joshua Tree NP monitoring control sites), Avian knowledge network, USFWS, Desert Tortoise Recovery, Academia
- Lessons learned from PEIS and REA processes,

Riverside East Monitoring and Adaptive Management Pilot

Next Steps

Next Steps

- Complete monitoring objectives
- Assemble background and existing information
- Develop monitoring and sampling schema
- Create and finalize monitoring plan

Outcome

Photo courtesy NextEra Energy

Final strategy will cover:

- Management questions
- Monitoring objectives
- Indicators
- Sampling framework
- Data collection and management
- Funding mechanism
- Adaptive management
- Lessons learned

Long-Term Monitoring Data Collection and Sharing

KEY OBSERVATIONS

- Use data from existing monitoring efforts (regional and project-specific) to:
  - Inform long-term monitoring strategy
  - Support monitoring activities
- Share data among agencies/organizations
- Develop partnerships for both data collection and stewardship
- Use new technologies to maximize efficiency of data collection (e.g., remote sensing)

Long-Term Monitoring Data Sources

EXISTING AND RELEVANT DATA, STUDIES, OR MODELS

- Solar PEIS and REA data (Sonoran and Mojave Desert)
- DRECP datasets
  - Vegetation data layer and attributes
- Databasin.org
- CEC website
- South Coast Wildlands
- Joshua Tree NP datasets: Night sky, air, invasive species, groundwater, wildlife observation, vegetation, paleontology, surface water, soundscapes
- Air quality data from Mojave Desert Air Quality Management District
- 2010 REA Lessons Learned
- Existing weather station data
- Point Blue Conservation Science avian data

Public engagement

- **1-2 issue-specific webinars in spring/early summer**
- **In person public workshop in summer**

(Subject to change)